

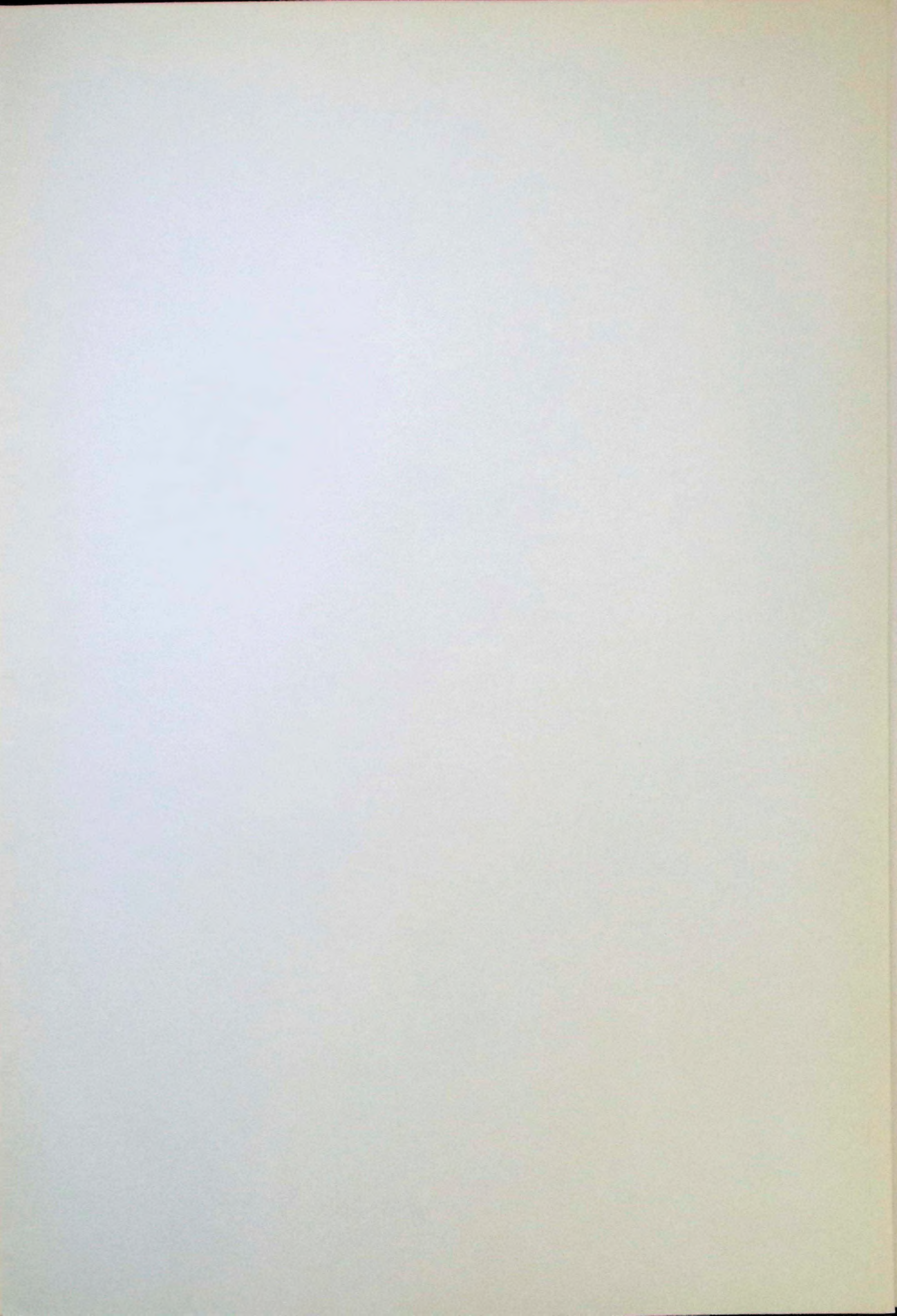
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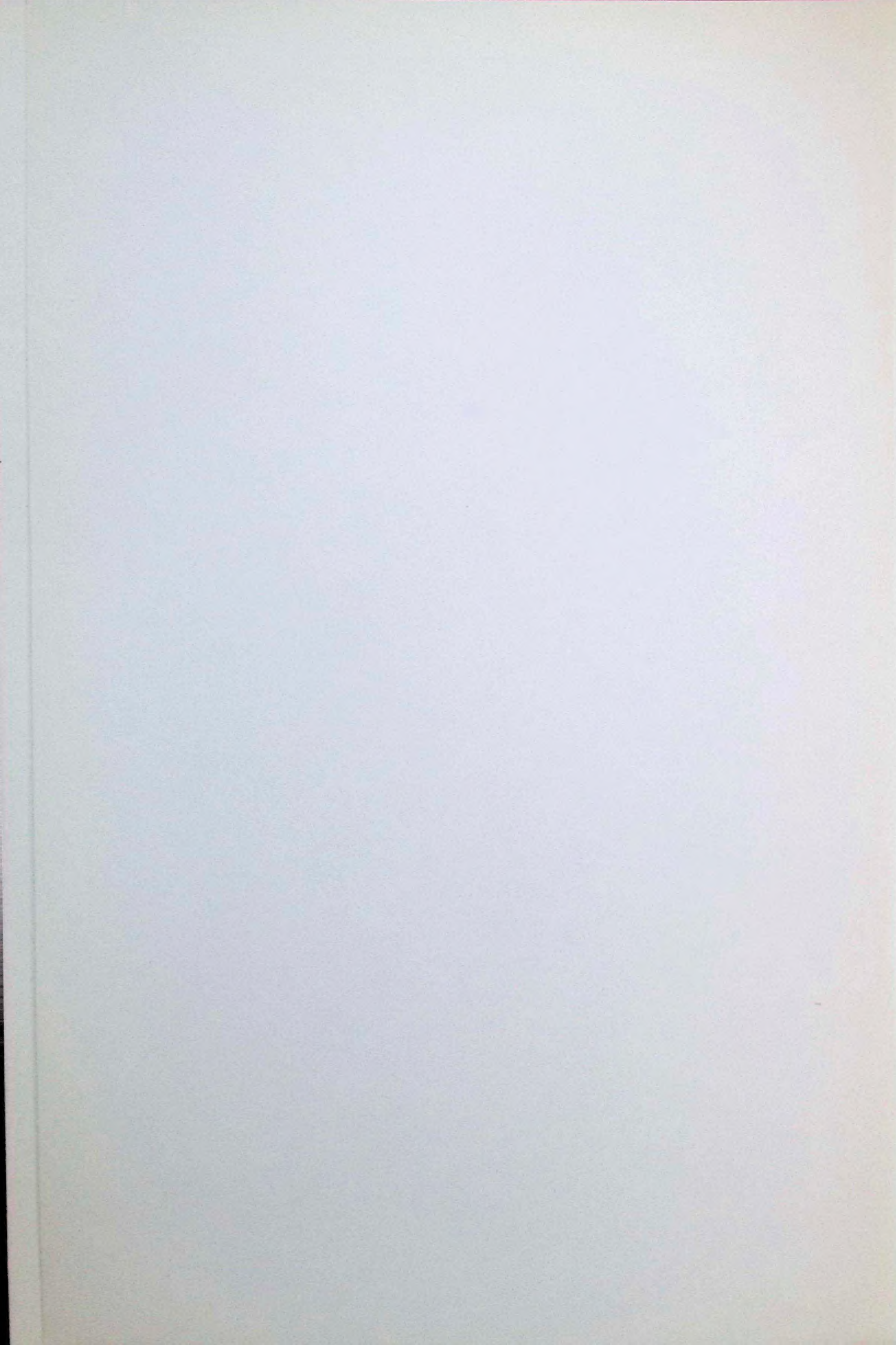
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1962

DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES
CANADA

1963





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OTTAWA 1963

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THE HISTORY OF NONMARINE MALACOLOGY IN BRITISH COLUMBIA

By ROBERT J. DRAKE*

ABSTRACT

A review of the studies in nonmarine molluscs and of the growth of collections in the area is given for the last century. Government field workers started collections that are still housed in the National Museum of Canada and in the British Museum (Natural History). Resident collectors of the British local-naturalist types made extensive accumulations of molluscs which have been mostly destroyed or dispersed. Study of molluscs is now centred at institutions; several amateur-naturalists are active. Museums in the United States possess representative samplings of material gathered by sporadic collecting forays into British Columbia during the last fifty years.

INTRODUCTION

In 1953 a prospectus was made to investigate the history of malacology for British Columbia and the terrestrial molluscan distribution there. It was not until the autumn of 1957, however, when the author was on the zoological research staff of the University of Arizona, that plans for the studies now being reported upon were made. It took about sixteen months to make the necessary preparations for the field work, which was started in the Fraser River drainage in May of 1959. Two research contracts from the National Museum of Canada provided basic support.

The 1959 field season lasted about ninety days and covered 5,123 miles; the 1960 field season, which lasted for about forty days, covered 5,268 miles. Of the two years, 1959 was the better one for field work, as heavy rains, interspersed with short hot spells of dry weather, fell in 1960 well into the summer; the fire hazards were great in many areas, and forest closures were frequently imminent.

Trips were made in 1960 to southerly and easterly peripheral areas of southwestern British Columbia in order to become familiar with conditions in other parts of the Pacific Northwest. In June, collecting was carried out on the Oregon and Washington sides of the lower reaches of the Columbia River. Northern Idaho and northeastern Washington were visited in late August for a preliminary assessment of the conditions existing in the westward fringes of the Rocky Mountain molluscan fauna. The Kootenay and Okanagan regions of British Columbia were also visited.

In 1959 two months were spent in residence and in trips to the lower Fraser drainage and the mainland area north of Vancouver; a month was spent in eastern and central Vancouver Island. Work in 1960 in the lower Fraser primarily consisted in checking on 1959 collecting sites; central and eastern Vancouver Island was again covered, with additional emphasis on the southerly area.

*Zoological Museum, The University of British Columbia, Vancouver.

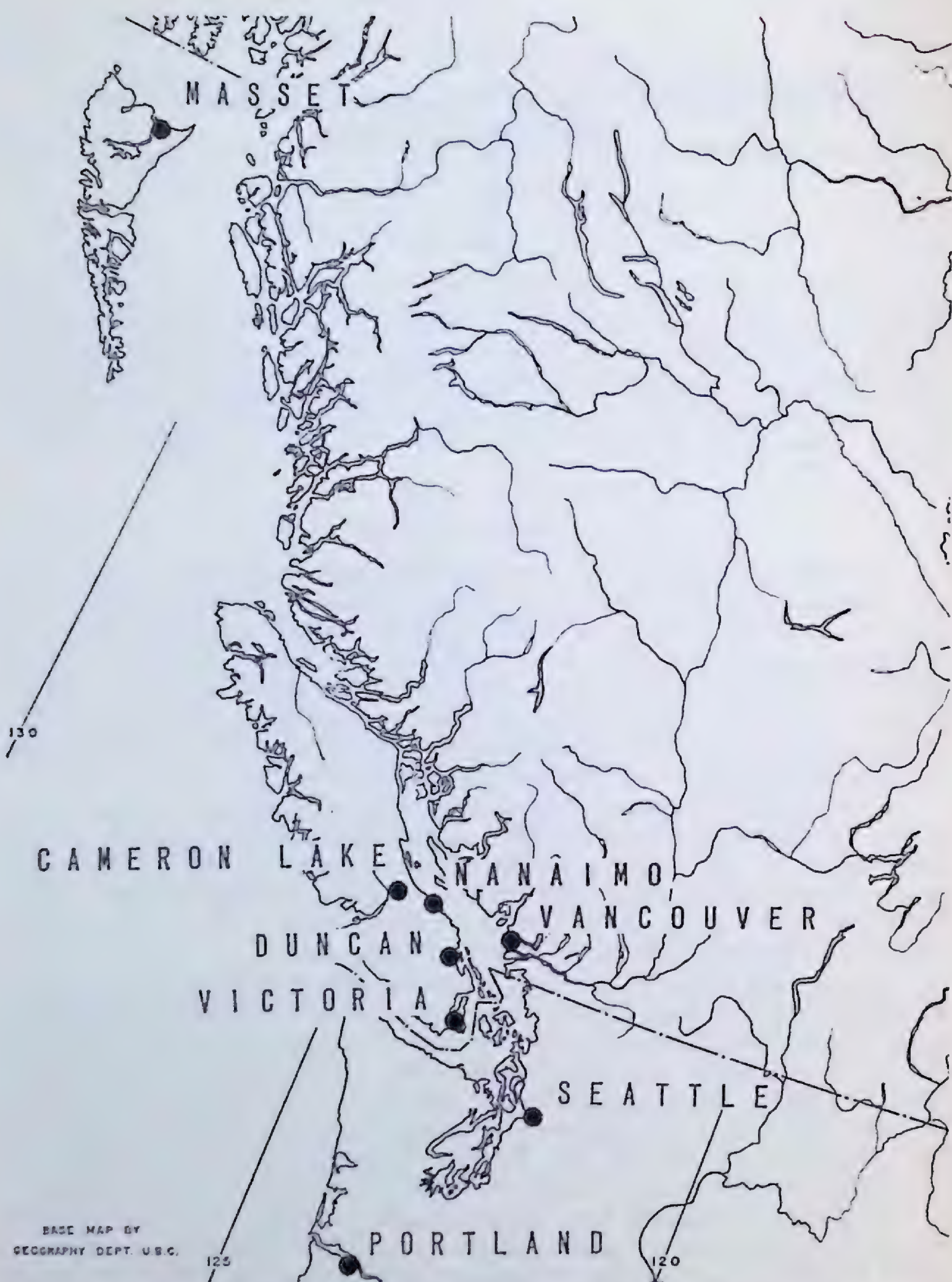


FIGURE 1. Pacific Northwest locations where early nonmarine malacology developed.

Facilities were kindly made available for the project in the Department of Zoology, The University of British Columbia, where in the autumn of 1959 a new four-storey wing was added to the Biological Sciences Building. In this wing, additional space and much-needed quarters for the invertebrate

portion of the Zoological Museum were provided, allowing for accumulations of molluscs to be entered into the records and displays of the Museum; some of these specimens were helpful in the distributional studies.

Specimens from British Columbia or other parts of the Pacific Northwest were borrowed for study from molluscan collections: San Diego Museum of Natural History, British Columbia Provincial Museum, California Academy of Sciences, Nanaimo Biological Station, the Department of Geology of Stanford University, and the National Museum of Canada. In connection with other western North American distributional and faunal research, visits were made to malacologists and to museums and libraries down the West Coast early in 1960. At that time some materials for the British Columbia research were consulted, and arrangements were made for later borrowing of specimens for study and comparison.

In September of 1961 molluscan collections made in British Columbia by John Keast Lord were studied in the British Museum (Natural History).

During and after the exploratory field work in 1959, it was realized, reluctantly, that, in general, there was a paucity of both numbers and forms for the nonmarine molluscan fauna in the Fraser drainage and on eastern and central Vancouver Island. Veterans of nonmarine molluscan collecting in the Northwest, such as Walter J. Eyerdam, Emery P. Chace, G. Clifford Carl, and Allyn G. Smith, had early advised that not too much would be found, a fact which, in itself, became of importance in the light of lack of diversity in the general ecological preferences of what eventually was considered to be the dominant terrestrial forms. In this paucity alone was seen part of the postglacial story of the fauna.

A series of topical reports is planned for the distributional and taxonomic aspects of the western Canadian work, the first of which has been prepared and may be issued concurrently with this historical introduction. It is entitled, "Studies on nonmarine Mollusca of British Columbia. 1. Postglacial history of six terrestrial genera."

ACKNOWLEDGEMENTS

I wish to extend my thanks to the following for their help in the preparation of this paper: L. S. Russell, Ian McTaggart Cowan, Hugh Hanham, W. Mack. Draycot, G. C. Carl, Miss M. Crummy, A. H. Clarke, Jr., Miss A. M. Keen, Rev. H. B. Herrington, W. A. Clemens, G. S. Spencer, Miss A. E. Dawe, J. C. Garner, M. S. Evick, J. R. Adams, D. B. Quayle, R. W. Pillsbury, P. A. Dehnel, E. P. Chace, W. J. Eyerdam, N. Harlow, Mrs. E. Wardroper, A. G. Smith, S. P. Dance, N. Tebble, John B. Burch, H. van der Schalie, and H. M. Laing.

My appreciation also is extended to The American Philosophical Society, whose Penrose Fund made possible my work at California institutions in early 1960; the National Science Foundation, for their travel and research grants which enabled me to visit Europe and to obtain additional background data in British Columbia; and the National Academy of Sciences, whose Marsh Fund permitted investigation in Britain in September of 1961.

COLLECTORS AND STUDENTS OF BRITISH COLUMBIA
NONMARINE MOLLUSCS

ROSTER AND COMMENTS

JOHN KEAST LORD (b. 1818, d. 1872). As naturalist to the British North American Boundary Commission, Lord collected a variety of natural history specimens in the vicinity of the 49th Parallel. He spent the period 1858 to 1862 from Fort Rupert on Vancouver Island south to central California; the Boundary party came from England via Panama. The molluscs he collected were submitted to the British Museum for study and report (Baird, 1863).

Lord's two-volume work of 1866, *The Naturalist in Vancouver Island and British Columbia*, has been criticized for its inaccuracy and for its lack of itinerary and collecting dates (Brooks and Swarth, 1925: 9). He published another book on his British Columbia experiences in 1867, *At Home in the Wilderness*, and wrote many articles on North American subjects in popular British periodicals such as *Land and Water* and *Leisure Hour* (Anon., 1873; Chichester, 1909). Born in Cornwall in 1818, he seems to have received what could reasonably now be considered a veterinarian's training; as an officer in the Crimean War he supervised the care of stock, and his principal work on the Boundary Commission apparently was to safeguard the animals in transit (Johnson, 1955).

It was mentioned by G. W. Taylor (1889: 84, 85) that the labels in the British Museum specimens from Lord's collecting have confused information. In particular, Taylor points out an "*Orthalicus zebra*" that was labelled as from Vancouver Island which probably originally came from tropic West Coast North America. This large bulimulid landsnail, an immature specimen with a narrow reddish band on the body whorl, bears the number 60.11.23-4. The label is in William Baird's handwriting in pencil, and the determination is *Bulimulus zebra*. For many of the lots, including those from the Okanagan and adjacent Washington, and presumably collected in the Northwest by Lord, the donor is "Lords of the Admiralty," such as was designated for shells collected by John Macgillivray during the voyage of the H.M.S. *Herald* (Smith, 1906: 708). Lord's molluscan collections, marine and nonmarine, totalled 918 specimens when accessioned at the British Museum (Smith, 1906: 709).

WILLIAM HEALEY DALL (b. 1845, d. 1926). One of the more able and better American-trained scientists of the 1800's, Dall was mainly responsible for the still increasing awareness of the scientific and economic potentialities of the Pacific Northwest and Alaska. Later in his life, when he was associated with the Smithsonian Institution, his collections and private library were placed in the Division of Mollusks of the U.S. National Museum in Washington, D.C. Living when he did and keeping up with advances in malacology abroad, he was able to make worthwhile contributions to the field (Pilsbry, 1927; Merriam, 1928; Bartsch, Rehder, and Shields, 1946).

GEORGE MERCER DAWSON (b. 1849, d. 1901). Probably most noted for the thoroughness of his reconnaissance reports on unknown portions of Canada (Ami, 1901; Haig-Brown, 1961: port., p. 251), Dawson made significant early collections of molluscs in British Columbia. He was one of the first Canadian-born scientists investigating the West.

JOHN M. MACOUN (b. 1831, d. 1920). As a field botanist for the Geological Survey of Canada, Macoun worked in most of the Prairie Provinces and in Western Canada. He collected molluscs for others to report upon (Whiteaves, 1905b; 1906). His last years were spent in retirement in Victoria (Macoun, 1922).

WILLIAM SPREADBOROUGH (b. 1856, d. 1931). Born in Farnham, England, Spreadborough came to Canada, and in 1888 he served as a cook for Macoun's field party. Apparently a natural collector, he worked with many of the later geologists and naturalists out of Ottawa. He also spent his last years in Victoria (Taverner, 1933).

JOSEPH BURR TYRRELL (b. 1858, d. 1957). This geologist, who lived nearly one hundred years, received his early field experience on one of Dawson's field parties in the Rockies in the 1880's. He collected some terrestrial snails, as he did his traverses. After Dawson became director of the Survey, Tyrrell left and became a consultant until his retirement (Alcock, 1958; Loudon, 1930; Shaw, 1958; 11-59).

JOSEPH FREDERICK WHITEAVES (b. 1835, d. 1909). Whiteaves grew up in England where he received an excellent education and at the age of 22 published a paper on the nonmarine molluscs around Oxford. He came to Canada in the 1860's, and eventually became palaeontologist and zoologist for the Geological Survey of Canada. He worked in British Columbia in the 1880's. Later he became one of the original Fellows of the Royal Society of Canada and received an LL.D. from McGill University in 1900 and the Lyell Medal of the Geological Society of London in 1907 (L [ambe], 1909; Woodward, 1907: 321).

In 1905 he described a new species of pleurocid freshwater snail as from the Columbia River drainage in British Columbia. To my knowledge, the form has not been found in any drainage in the Province; it has been shown (Goodrich, 1937) that his 'type lot' probably resulted from the mixing of museum specimens.

HENRY HEMPHILL (b. 1830, d. 1914). Hemphill's work as a mason in California took him to out-of-the-way places and allowed him to accumulate funds for long periods away from work and to finance field trips (Dall, 1914). He pioneered in the rich and distinctive terrestrial fauna of Idaho in the 1880's but perhaps only once got into British Columbia, about 1910 or shortly thereafter (Miss A. M. Keen, in litt., 17 December, 1959). His large collections were fortunately deposited at Stanford University (a large series of duplicates) and the California Academy of Sciences (the main collections). He exchanged heavily with Herbert Nelson Lowe and others in the San Diego - Los Angeles region in Southern California, and the San Diego Museum of Natural History has fair representation and documentation of his collecting in the West.

HAROLD HANNIBAL. Little of Hannibal's life has been covered in the natural history literature. He was an intense student in palaeontological studies at Stanford University. Western North American malacology and palaeontology undoubtedly suffered a great loss when he received an injury which prevented him from continuing his work. He did some field work in

the Northwest around 1910; his publications show that he was well aware of what had been done previously in the nonmarine molluscan fields in the West (Hannibal, 1912). For some reason, much of his work has not stood up under investigation; possibly it was considered to be far more subjective than it actually was.

J. H. KEEN. According to Osgood (1901: 9), Keen was a missionary at Masset, Queen Charlotte Islands, for at least eight years in the 1890's. C. Hart Merriam named a bat, *Myotis keeni keeni*, for him in 1895, and he supplied Osgood with basic information concerning the vertebrate fauna of the Charlottes. He sent terrestrial slugs to the British Museum from Vancouver Island (Cockerell, 1891) and collected in several other categories of natural history.

GEORGE W. TAYLOR (b. 1851, d. 1912). Second only to Dall's, Taylor's influence on the growth of biological research on the Pacific Coast was tremendous (Hanham, 1912; Hanham and Fyles, 1912; Tomlin, 1913; Prince, 1912, 1913). He was a key figure in Canadian science at the turn of the century. Little is known of his interest in philosophy other than that he became a man of the cloth, but his ideas were provocative and influential (Taylor, 1895a and b; Fisheries Research Board of Canada, 1958). Yet today there are virtually no primary source materials left relating to Rev. Mr. Taylor, for his correspondence, newspaper clippings, albums, and notebooks have disappeared. He returned to England several times and seems to have kept up with British friends with molluscan interests. In collections or museums in England, there may exist fair representatives of his molluscan collections from Canada. From the little that remains of his collection in British Columbia, deposited in the Zoological Museum of The University of British Columbia, it can be seen he was interested in specimens from other lands and waters and must have acquired them in some measure by exchange. Marine shells that had been in the Suter, Rolle, and Crosse collections may have been purchased after the Nanaimo biological station was established.

He was well known as an entomologist, especially a coleopterist (Hatch, 1955: 563), and the fate of his insect collection is not presently known to me; it may have been sold well before the Nanaimo station was founded.

CHARLES FREDERICK NEWCOMBE (b. 1851, d. 1924). Coming from Newcastle-on-Tyne in England, Newcombe received a medical education there but spent most of his life in British Columbia (Connell, 1924). He seems to have been an amasser of fine examples of native arts and crafts and did collecting for some of the large museums in the East. He left a large personal collection of marine and nonmarine shells, Northwest Indian art objects, and books. Newcombe's son, William, of Victoria, inherited his father's collections; he died in November of 1960, and the Government of British Columbia purchased the library and the natural history and other collections.

ABDIEL WILLIAM HANHAM (b. 1857, d. 1944). Hanham spent most of his working years in the banking business, after which he enjoyed a long retirement. His large insect collection is in the British Columbia Provincial Museum. His library evidently went the way of the booksellers,

and most of his molluscan collections he donated to the Royal Ontario Museum of Zoology during his last years.

Dr. G. Clifford Carl (British Columbia Provincial Museum) and Dr. W. A. Clemens (The University of British Columbia) provided the following information concerning Hanham:

About 1940 Hanham made arrangements to transfer his molluscan collections to the Royal Ontario Museum of Zoology in Toronto, Ontario; the Provincial Museum carried out the task of shipping them. Hanham wanted representative samples of the local molluscs to remain in British Columbia as well. Dr. Carl and Dr. Clemens accordingly made a selection of about three hundred lots; these were divided between the Department of Zoology of The University of British Columbia and the Provincial Museum. The latter institution's set was later transferred to the Provincial Shellfish Laboratory at Ladysmith, where Dr. D. B. Quayle was conducting molluscan research; when the laboratory at Ladysmith became inactive and Dr. Quayle transferred his research programme to the Nanaimo Biological Station, the lots were again transferred. There, in the summer of 1959, the author studied about 150 lots of the nonmarine molluscs and designed a catalogue for them.

Hanham came to the United States from England in the 1880's and lived in and near Duncan on Vancouver Island. He was sent to Duncan by his employer and, living for many years after G. W. Taylor, he did much to contribute to the malacology of southwest British Columbia (Downes, 1945).

His natural history interests were deep, and they developed early. After coming to Canada, he continued his studies in nonmarine molluscs in the East and in Manitoba (Hanham, 1893 and 1897).

Mr. Hanham's son, Hugh, of Duncan, kindly provided much information about his father and about the stages and states of field and cabinet conchology as practised near Duncan.

IDA S. OLDROYD (b. 1856, d. 1940). Active at Stanford University, California, through the 1930's, Mrs. Oldroyd was interested principally in marine life (Anon., 1942). She exchanged with Rev. Mr. Taylor just before his death and, about 1930, made a visit to Nanaimo to examine the remaining shells in his collections. Her collection at Stanford became the centre for deposition of several nonmarine collections; thus they were saved for later study by Junius Henderson and others.

C. MONTAGUE COOKE, JR. (b. 1874, d. 1948). Long a resident of Hawaii where he was a builder and late patron of nonmarine molluscan collections at the Bernice P. Bishop Museum (Kondo and Clench, 1952), Cooke spent part of the summer of 1922 on Vancouver Island (Pilsbry and Cooke, 1922). At a crossroads about four miles south of Union Bay, and at the 'lower' end of Cameron Lake, he made collections which were later reported upon by H. A. Pilsbry. At Cameron Lake he found one of the last 'new species' to be published for British Columbia land snails. He wrote that "Land shells were nowhere found in abundance, and in many places they seemed entirely wanting."

It was also stated by him that paratypes of *Microphysula cookei* (Pilsbry) [= *Zonitoides cookei*] were deposited in the Bishop Museum. However, Dr. Yoshio Kondo (in litt., 28 June, 1960) informs me that he

can find nothing from British Columbia in the nonmarine collections at the Bishop Museum and recalls that Cooke once told him all such were sent to Pilsbry at the Academy of Natural Sciences of Philadelphia (Pilsbry, 1922).

CHARLES McLEAN FRASER (b. 1872, d. 1946). A world authority on hydroids, Dr. Fraser was for the area perhaps the first nearly current-type scientist-administrator. He came from Eastern Canada and graduated from the University of Toronto in 1898. In 1912, the year of George W. Taylor's death at Nanaimo, he received his doctorate from the University of Iowa. Before that time he had taught school in the interior of British Columbia for several years and had worked intermittently at the biological station at Nanaimo after its founding in 1908, where he was director from 1912 until 1924. In 1920 he became professor and head of the Department of Zoology of The University of British Columbia; he retired in 1940 (Clemens, 1947). The 1959-completed wing of the Biological Sciences Building at the University was dedicated to him. Although greatly interested in molluscs, particularly as marine organisms, his work was confined to collecting. Because of the need to house his rich collection of hydroids, 'invertebrate collections' were given more and more import and space, and through several departmental relocations they reached a place in the University museum system. The invertebrate collection has well over 10,000 catalogued items of present and future research importance for taxonomical and distributional studies. In addition to the many basic series of zoological literature that he left the departmental library and the University Library, his contribution to local malacological research was the early build-up of the idea of an invertebrate portion of what has become the Zoological Museum of The University of British Columbia.

E. NEWTON DRIER. A large collection of world-wide marine and nonmarine molluscs, assembled by the late Dr. Drier (a medical doctor) has been deposited in the Vancouver City Museum. Little is now known there about him; he evidently exchanged much with A. W. Hanham, as evidenced by the Duncan and Maple Bay (Vancouver Island) localities represented. He is listed in the International Directory of Malacologists as having molluscan interests as far back as 1927 (Smith, 1939: 33).

WALTER MacKAY DRAYCOT. A British veteran of the Boer War and a Canadian veteran of World War I, Mr. Draycot has maintained the same address in Lynn Valley, North Vancouver, for nearly fifty years. He had a long interest in molluscs and especially in the Pleistocene marine forms of his area. In later years he became quite interested in collecting local nonmarine molluscs and has occasionally reported on them. A recent contribution (1961) dealt with records of some introduced terrestrial gastropods in the Lynn Valley area.

WALTER J. EYERDAM (b. 1892). Living at Seattle, Washington, since before World War I, Eyerdam attended the University of Washington and early in life became interested in several trades which took him seasonally to Alaska for over twenty years. It was his good fortune to be a collector on many expeditions from prominent museums and universities in some sixty countries; his collecting ability in most natural history fields is noteworthy. About 1915, on meeting Mrs. Oldroyd when collecting on

Puget Sound beaches, he became interested in collecting and studying molluscs. He made his first molluscan exchange by mail with William J. Clench, now of Harvard University, about the same time; a large molluscan collection, especially rich in material from type series, was brought together in Seattle; much of this has recently been acquired by the Chicago Natural History Museum. He exchanged with Hanham and has done occasional determinations for the British Columbia Provincial Museum.

ALLYN G. SMITH (b. 1893). After graduation from the University of California at Berkeley, Smith worked as an administrator with the Pacific Coast division of the Bell Telephone and Telegraph companies until his retirement a few years ago. Long interested in the systematic study of molluscs, he became associated with the California Academy of Sciences in a research capacity early in his career in communications. Since 'retirement' he assumed administrative duties with the Academy during its recent expansion; currently, he is organizing the invertebrate collections of the institution in one museum department. Later, and during an era of growth of transportation systems in the West, he performed field studies and made reports on inland molluscan work, much neglected since the death of Henry Hemphill. In 1943 he published a report on Idaho molluscs extending into British Columbia. In 1952 and 1960, he collected non-marine molluscs in southern British Columbia and Alberta, most of which have been deposited in the California Academy of Sciences.

L. S. RUSSELL (b. 1904). Born in Brooklyn, New York, Dr. Russell came to Canada at an early age, growing up and receiving his undergraduate education in Alberta; his doctorate was in palaeontology from Princeton University. He worked many years for the Geological Survey of Canada as a stratigrapher and palaeontologist. A charter member of the American Malacological Union, he has contributed to the Mesozoic and Cenozoic palaeontology of the nonmarine molluscs in the Rocky Mountain region and has reported upon modern faunal assemblages. By his own definition, he is a palaeozoologist. He served in the Canadian Army during World War II as a specialist in electronics with the rank of major. In 1950 he left the Royal Ontario Museum of Palaeontology and became chief of the Zoological Section of the National Museum of Canada. In this capacity, he did field work in malacology and palaeontology in British Columbia in the early 1950's, prior to his appointment as Director of the National Museum on the retirement of Dr. F. J. Alcock.

R. J. DRAKE (b. 1922). Born in San Diego, California, Drake spent his early years in northern California and the late 1930's in Palo Alto, near Stanford University. Through early contact with Dr. A. Myra Keen, the late Mrs. Oldroyd, and the late Dr. Hubert G. Schenck, of the Department of Geology of Stanford, he obtained an introduction to museum malacology, faunistics, and nomenclature; to the history of collecting and collections in the West; and to scientific literature. About 1947 a field programme for taxonomy and distribution of terrestrial molluscs for Western North America was started. It was carried out intermittently in Northwest Mexico, the Rocky Mountain states, the southwestern states, and in 1959-61 in British Columbia and other parts of the Pacific Northwest. His primary interest is in how far some of the modern nonmarine molluscs of

western North America extend back in time in the specific localities in which they are now found. As a study technique, findings of molluscan remains in early man and later archaeology are utilized for accumulating raw data.

RÉSUMÉ

In particular, the earlier of these investigators, and a few others like them, laid the groundwork for nonmarine molluscan faunistic studies for Western Canada. Some of the collections they made are either no longer extant or available in the West. Yet, they helped to record the variety and ranges of the terrestrial and aquatic pulmonate populations occurring in the general British Columbia region.

A lifelong amateur preoccupation with insects and Mollusca and long periods of residence at localities such as Victoria, Duncan, and Nanaimo enabled Taylor and Hanham to assemble good collections of specimens existing in the area. Only an insignificant part of Taylor's own collection now exists as a museum unit; Hanham's shells, in most part, eventually went to the United States. Their continuous sending of specimens to Pilsbry and Dall caused distribution records to be published in short papers or in the monograph on the terrestrials by Pilsbry in four volumes (1939-1948). In this respect, Taylor's efforts in the 1880's and 1890's probably made a worthwhile regional contribution to the Dall monograph of 1905 then in preparation.

As the above-mentioned naturalists found time for constant and continuing field work, and carried it out mainly for how much of what was in the area, valid conclusions on distribution can be drawn from what they failed to find. Also, Taylor and Hanham were excellent conchologists and evidently had exceptional memory for detail. Taylor was a compiler and a recorder and was thoroughly engrossed in natural history studies and probably had an interest throughout his life as to their true value. He did see the founding, mostly as a result of his efforts, of the federal biological station at Nanaimo.

Hanham's collection of molluscan literature, on the other hand, may have been small in comparison to Taylor's. In later years and during his long retirement, his collections became a source of enjoyment, but about thirty years before his death he stopped publishing on his molluscan findings; his natural history activities may have changed in his later period as he is remembered now in British Columbia rather as an entomologist.

Samuel N. Rhodes of Philadelphia (Cope, 1894) made a herpetological collecting trip in southeastern British Columbia in the early 1890's. The Rhodes Collection of molluscs now reposes in several museums in the United States. Perhaps Rhodes collected nonmarine molluscs in British Columbia.

FATE OF THE EARLY SHELL COLLECTIONS

TAYLOR COLLECTION

At the time of his death in 1912, George W. Taylor had at the Nanaimo station a large shell collection in which there were especially fine examples of marine limpets and freshwater unionid bivalves. After

his death, most of his collection was put into the attic of his home on the edge of the station grounds. Some years later, Mr. and Mrs. Cyril J. Berkeley, of the Nanaimo station, purchased the house and have lived in it ever since. By the time they became its owners, the stored shells in the attic, which had been mixed by rodents, were adjudged worthless to science. Eventually the collection was transferred to the lumen of an unsuccessful well on the property and covered over with earth.

About 200 lots of the Taylor Collection eventually came to rest at The University of British Columbia. One of Taylor's sons had a small wooden set of drawers with marine limpets in it. At the death of Taylor's son, it was given to the Department of Zoology. However, the specimens and their labels were mixed. There were also several wooden boxes with large limpets, but these too were mixed. Although Taylor carefully catalogued his shells by numbers, no records have been located.

Taylor's specimens in the invertebrate portion of the Zoological Museum of The University of British Columbia ("UBCIM" ... "Invertebrate Museum") are now of more historical than biological interest. His marine limpets were from the Suter, Crosse, Rolle, and other collections (A. H. Cooke, 1899; Hedley, 1918; Anon., 1919; Tual, 1899) and were perhaps purchased toward the end of Taylor's life; there are some duplicates from early voyages such as the *Astrolabe*. Taylor's copy of the two-volume marine limpet portion of the *Manual of Conchology* remains in the Library (call number: QL 403/T. 1890) at the Nanaimo Biological Station; evidently he placed great store in making a representative collection of limpets. The books are beautifully bound with rice-paper interleaves, and notes and original descriptions have been legibly and carefully copied from older works. Some exchange shells were from California and Oregon collectors: Fred L. Button, Robert H. Tremper, Mrs. Marie Drake, and Harvey E. Dore (Solem, 1960; Drake, 1895 and 1896; Hill, 1934; Dore, 1891; Johnson, 1928).

Two neatly packed cardboard boxes of southern California exchanges were located, stored in the invertebrate collections and entered in the Zoological Museum of The University of British Columbia in the summer of 1960. Possibly C. McLean Fraser brought them to Vancouver from the Nanaimo station when he was working out of both institutions. These may be the exchanges that Taylor received just prior to his death. Some shells were common southern Californian land and marine forms and were perhaps collected by Ida Shepard, then living in Long Beach, California, before she became Mrs. Tom Shaw Oldroyd in 1895.

In the Herbert N. Lowe Collection and Library bequest to the San Diego Museum, an exchange list originating with the Rev. Mr. Taylor (Taylor [?1890-?1900]) was located in February 1960.

NEWCOMBE COLLECTION

Fortunately the C. F. Newcombe collection is still intact and is now in the Provincial Museum. Thus, it fared better for British Columbia history-of-natural-history import than did either the Taylor or Hanham collections. Records of both the Taylor and Hanham work may be found in the Newcombe accumulations. (In the files of the Provincial Archives there should be a record of the remaining literature that Newcombe drew upon for his determinations and general interest in molluscan studies in

the days before rapid communication methods; it will be interesting to see if he exchanged for items from other places or was content to build a local collection.)

HANHAM COLLECTION

This collection did not suffer the vicissitudes that Taylor's did. It was saved from destruction but in the main was moved away from British Columbia. Earlier, it has been recounted why and how Hanham donated most of his accumulated shells to the Royal Ontario Museum of Zoology. After World War II it was again transferred, this time to the molluscan section of the University of Michigan Museum of Zoology at Ann Arbor. Very meagre representations of Hanham's British Columbia collecting are at the Biological Station at Nanaimo and in the Zoological Museum of The University of British Columbia.

According to Hanham's son, Hugh, his father was careful of records and maintained a continuous catalogue for serial numbers and other information. The shells in the Nanaimo and Vancouver collections were originally in sturdy envelopes and appear to have been made up as exchange lots with most information except dates of collection and any serial numbers. Rev. H. B. Herrington (in litt., 22 June, 1959) kindly made a search at Ann Arbor for the extent of information on labels, original labels remaining with Hanham's shells, and so forth; he found little information (other than notations concerning British Columbia). In response to inquiries concerning a possible Hanham catalogue at Michigan, John B. Burch (in litt., 21 December, 1959) kindly informed me that there was no record of it when the collection was accessioned at the University of Michigan Museum of Zoology.

CURRENT INSTITUTIONAL MOLLUSCAN COLLECTIONS

BRITISH COLUMBIA PROVINCIAL MUSEUM

As the oldest continuing government-financed museum in the Province, the Provincial Museum has been the recipient of molluscan materials for well over half a century. The collection of marine molluscs is representative of the area; the nonmarines are moderately well covered, with occasional lots and some interesting spot-distribution records from outlying parts of the Province.

In recent years, members of natural history survey-type expeditions of the Museum have collected inland molluscs, which have been listed in general reports (Carl, Guiguet, and Hardy, 1951 and 1952; Carl, 1944 and 1953; Hardy, 1955). Molluscs from several of the collectings were sent to Rev. H. B. Herrington in Ontario and Mr. Walter J. Eyerdam in Seattle, Washington, for identification.

These recent collections perhaps give some current indications of the paucity of the native molluscan faunas and apparent small population sizes in comparison to those of some other invertebrate groups.

ZOOLOGICAL MUSEUM OF THE UNIVERSITY OF BRITISH COLUMBIA

As previously noted, small portions of the Hanham Collection and of the Taylor Collection have been deposited permanently in the invertebrate

section of this Museum. Twice in the last decade the invertebrate collections have been moved into new and larger quarters. There are around 6,000 lots of both marine and nonmarine molluscs now catalogued; of these, the majority are British Columbian, Panamic Province, and other West Coast marine forms.

Among the many collectors represented are C. McLean Fraser, G. J. Spencer, I. McT. Cowan, W. A. Clemens, G. C. Carl, R. W. Pillsbury, T. G. Northcote, C. C. Lindsey, P. A. Larkin, P. A. Dehnel, and D. B. Quayle.

Other nonmarine British Columbia shells are in the collections of the National Museum of Canada, Ottawa; the Academy of Natural Sciences, Philadelphia; and the United States National Museum, among others.

SUMMARY

The history of malacology in British Columbia began with the collecting activities of members of first British and then Canadian government inland exploration groups. By the 1880's, a few Britishers, who were to avidly practise cabinet conchology, migrated to Vancouver Island.

Rev. George W. Taylor started his New World vocational life in quite a small way in Victoria. After preparation for the ministry, he was ordained there in 1885. He held pastorates in the region, off and on until his death at Departure Bay near Nanaimo in 1912. He had nominally been in charge of the federal fisheries biological station at Departure Bay, several miles north of Nanaimo, since its founding in 1908. This is now the Pacific Biological Station of the Fisheries Research Board of Canada, Nanaimo. Taylor was in the Ottawa, Ontario (L[atchford], 1893; Latchford and Fletcher, 1899) area from about 1893 to 1895. In 1896 he resigned from his St. Albans post in Victoria, with plans to return to England. He must have made a trip back to England perhaps about 1888, as he related in 1895 that he had examined shells collected by J. K. Lord in the 1860's that were then deposited in the British Museum (Natural History) and are still there. He mentioned E. A. Smith, who was in charge of molluscs in the British Museum at that time (Woodward, 1917; Smith, 1906), as if he knew him not only through correspondence but in a personal way (Taylor, 1895a and 1895b).

During Taylor's time *The Nautilus* and *The Ottawa Naturalist* were monthly magazines which he must have made good use of in his exchange work and in obtaining help in identification of species. It was probably Dall's notes reporting upon work in Oregon (1890) and Hanham's early exchange notices in *The Nautilus* that brought Taylor into contact with these fellow naturalists. Ten years later, Dall (1900) published upon a Vancouver Island marine nudibranch mollusc sent to him by Rev. Mr. Taylor.

To Victor Sterki (Brooks, 1933) of Ohio, and Henry A. Pilsbry (b. 1862, d. 1957) of Philadelphia, Taylor also sent material for identification (Sterki, 1889; Pilsbry, 1939-1948). And it was possible that Hanham and Newcombe followed the same practice in determinations. The three major Vancouver Island mollusc students exchanged. In a locality list of marine molluscs for British Columbia, Newcombe mentioned much help from Taylor (and J. H. Keen) for collecting stations (Newcombe, 1893).

As Hanham had early reported on his molluscan activities while in residence in Quebec and Manitoba, Taylor did likewise (Taylor, 1889, 1893, and 1894) for British Columbia.

Figure 1 shows the principal Pacific Northwest localities mentioned in this review.

In addition to the historical outline presented in this paper (pp. 4-10), information on the history of the early workers in Canada may also be found in perusal of items in the bibliography to A. LaRocque's catalogue of the *Mollusca of Canada* (LaRocque, 1953: 347-377).

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FISHES OF THE 1960 "SALVELINUS" PROGRAM FROM WESTERN ARCTIC CANADA

By D. E. McALLISTER

In the summer of 1960 the author joined with J. G. Hunter of the Fisheries Research Board of Canada on the M.V. *Salvelinus* to study the fishes of western Arctic Canada, particularly in the vicinity of Herschel Island, Yukon Territory. This area is of interest because of the possibility of encountering Pacific or Siberian forms. Herschel Island (see Figure 4 for location) has received little ichthyological attention. Scofield visited the island in 1896 and collected five species of fish (Scofield, 1899) including a new species which he named *Liparis herschelinus*. Frits Johansen visited Herschel on the Canadian Arctic Expedition of 1913-18 and collected three species of fish. In 1955 Walters published on Johansen's manuscript of the fishes of the expedition after examining some of Johansen's specimens.

The present paper records thirty species of fish from the Herschel Island area and fourteen from the Aklavik area for a total of thirty-six species. Three of these have not previously been recorded from the Canadian Arctic (McAllister, 1960, 1960a). Descriptions and systematic comments are presented for each species. At the end of the systematic section, the faunal allocation of Herschel Island fishes is discussed.

Collecting began on July 6 in the Peel Channel of the Mackenzie River and in tributaries near Aklavik. Until July 24, the temperature of the muddy waters of the Peel Channel ranged from 13° to 15°C. Tributary waters were cooler and often clear. The weather during this period was comfortably warm at Aklavik.

On July 23 the party left Aklavik on the 37-foot Fisheries Research Board M.V. *Salvelinus* with J. G. Hunter, Capt. I. Gidney, and J. Bray, of the Fisheries Research Board, and the author. The expedition travelled downstream to the mouth of the Mackenzie River and into the Beaufort Sea, and then proceeded toward Herschel Island. Muddy water of Mackenzie origin ceased at Kay Point, some 75 miles west of the river mouth. The temperature of the muddy water off the mouth of the Mackenzie was 10.5°C, while 10 miles from Herschel Island and at the Island the temperature of the clear, brackish water was 6°C. We arrived at Pauline Cove on July 24. Pauline Cove was made headquarters, and trips were made from there.

Fish were collected with seines, floating and sunken gill nets, dip nets, otter trawls, and ichthyocide. Gill nets set outwards from the shore were generally productive; floating gill nets set away from the shore were often empty. Biological data were collected for the Fisheries Board, as well as scientific specimens for the National Museum of Canada. Only the specimens caught for the Museum are reported on here.

Surface water temperature from July 24 to August 26, depending on wind and ice conditions, varied from 2.3° to 9.5°C, salinity from 6‰

to 18‰. Temperatures below 0°C were generally found at 10 to 15 metres and deeper. The temperature at 76 metres depth off Collinson on August 6 was -1.43°C, the salinity 32.97‰. Except for the gravel or sand shores, the bottom around Herschel Island was mud, sometimes with shells, wood chips, or grass clumps. Weather was generally cool, but not cold, and most days were partially or completely overcast. Fog was not infrequent. There was one day with snow. A wind of about 50 mph was experienced on August 20, and winds of 35 mph were experienced on several occasions. Pauline Cove provided a sheltered anchorage from most winds. Ice conditions were good; ice fragments were seen on only five or six days, only once sufficiently large to impede work.

The systematic portion of the paper is presented first. Families are dealt with in phylogenetic order. Faunal relationships are discussed at the end of the paper.

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SYSTEMATIC SECTION

Measurements were made with dial calipers accurate to 0.1 mm. Proportions were determined with needle-point dividers. Standard length was taken to the caudal flexure, head length of the bony edge of the operculum, and depth as the greatest vertical portion of the body. If the last two rays of the dorsal and anal arose close together, as if on a single basal, they were counted as one; if they arose distantly, each was counted. Gill-raker counts are presented as the upper + the lower limb counts = the total, a raker at the bend being included with the lower limb count. All rakers including rudiments were counted. 'D' is the abbreviation for dorsal, 'A' for anal, 'V' for ventral, 'P' for pectoral, 'Br' for branchiostegals, 'L.L.' for lateral line scales, and 'G.R.' for gill rakers. Bilateral characters were determined on the left side.

PETROMYZONTIDAE

Entosphenus japonicus (Martens)

Arctic lamprey

A lamprey, probably *Entosphenus japonicus* (Martens), was observed by Joseph Bray on the back of a smelt in a gill net at Pauline Cove, Herschel Island, on August 15. Unfortunately the lamprey slipped off before it could be caught. *Entosphenus tridentatus* is known north only to

the Bering Sea, while *E. japonicus* is quite well known from western Arctic Canada. M. Riske (see under herring) and other authors have recorded this species from the Mackenzie delta area.

CLUPEIDAE

***Clupea harengus pallasii* Valenciennes**

herring

Herring were caught at Simpson Point, Herschel Island. The preserved specimens range in standard length from 153 to 246 mm. The number of keeled scales between the ventral and anal fins varied from 11 to 12, placing them in the subspecies *pallasii* according to Svetovidov (1952). In life, the colour was silver with blue and purple iridescence. Since a detailed systematic study was made on herring from this area by Morley E. Riske in 1960 as a M.Sc. thesis at the University of Alberta, no further comments are made on this species.

SALMONIDAE

***Salvelinus alpinus* (Linnaeus)**

Arctic char

Arctic char specimens were caught at Simpson Point, Herschel Island. The standard length of four specimens varied from 379 to 417 mm. Specimens were also caught, but not kept, from Peel Channel near Aklavik.

Depth 4 to $5\frac{1}{4}$, head length $4\frac{1}{4}$ to $4\frac{5}{8}$ in standard length.

D 11; A 9-10; P 13-15; L.L. 129-134; Br 11-12; G.R. 9-11 + 12-13=21-24; pyloric caecae 22-32. Light spots on side of body equal to or less than diameter of pupil.

The number of gill rakers identifies these specimens as *Salvelinus alpinus*, rather than *S. malma*. Schofield (1899) records *S. malma* at Herschel Island, but his specimens were probably *alpinus*. *S. malma* has not been definitely recorded north of Kotzebue Sound, Alaska. For a comparison of the two species, see McPhail (1961).

***Coregonus sardinella* (Valenciennes) (=C. albula)**

least cisco

The least cisco was caught at Simpson Point, Herschel Island, and in Peel Channel 2 miles above Aklavik. The first were 149 to 178 mm, the latter 218 to 241 mm in standard length.

Depth 4 to $5\frac{1}{4}$, head length $4\frac{4}{5}$ to $5\frac{1}{6}$ in standard length. Length of longest dorsal fin ray exceeds head length. Orbit exceeds three-quarters of the interorbital width. Pectoral reaches more than half-way to pelvic base.

D 10-11; A 12-14; V 11-13; P 15-16; L.L. ca. 80; G.R. 15-16 + 26-30=41-46; pyloric caecae 56 (in one specimen). Colour silvery, lacking the usual brassy tone of *nasus* and *clupeaformis*. Tip of chin black. Inter-radial membranes of ventral and anal black; this colour reduced to a few chromatophores in specimens under 200 mm. Mandible projecting in front of upper jaw. Upper lip in straight line with forehead.

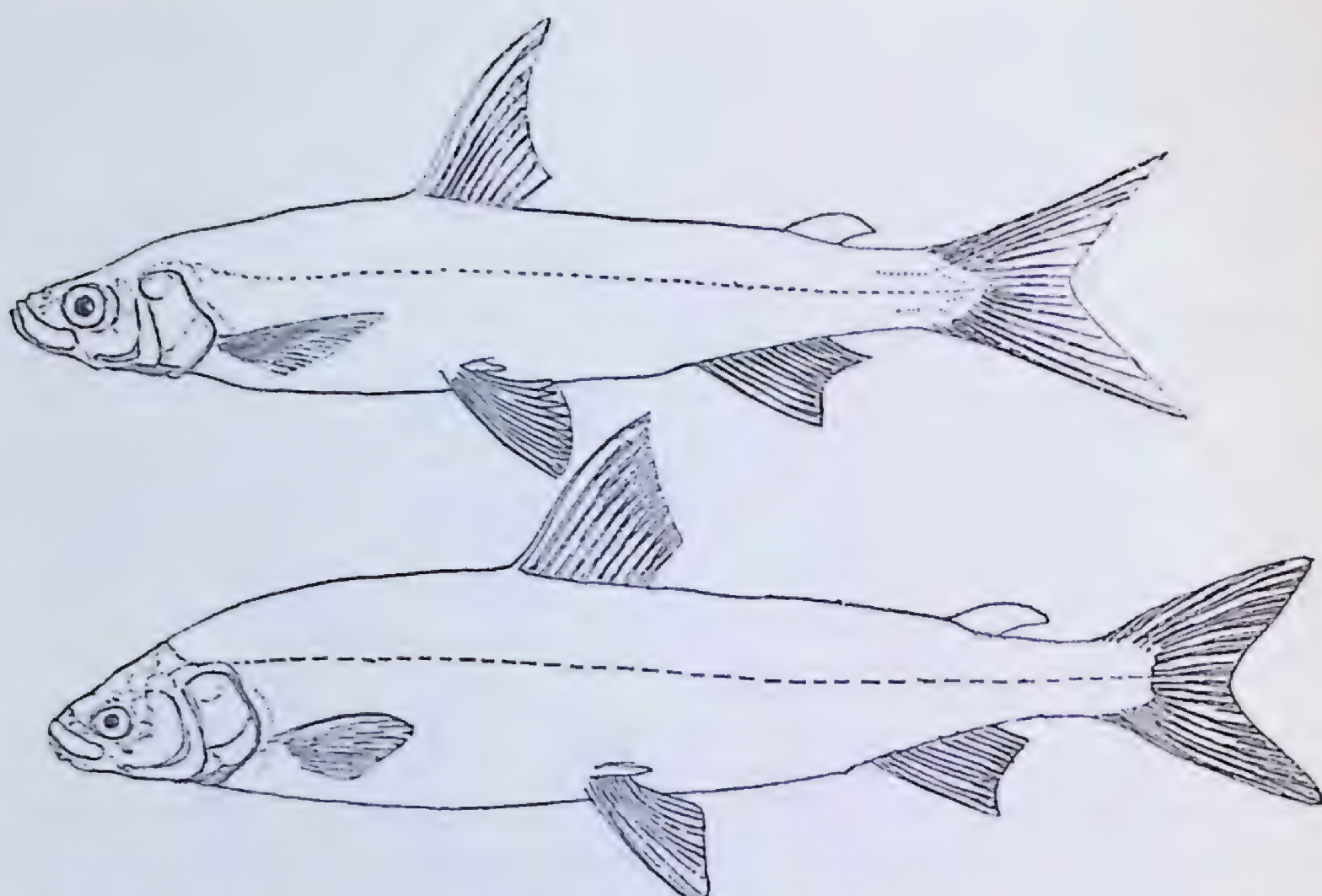


FIGURE 1. Above *Coregonus sardinella* ♂ 178 mm. Below *C. autumnalis* ♂ 207 mm. Note larger eye, dorsal and pectoral fins, and steeper premaxillaries of *sardinella*. Both from Simpson Pt., Herschel Island.

This species can be readily separated from *C. autumnalis* by the lower jaw curving in front of the upper; the high dorsal, whose length exceeds the head length; the pectoral reaching more than half way to the pelvic; the black pelvics; the larger eye. (See Figure 1 for a comparison of the two species.)

Coregonus autumnalis (Pallas) (= *C. oxyrhynchus*)

Arctic cisco

The Arctic cisco was caught in Peel Channel above Aklavik and at Simpson Point, at Pauline Cove, and at Orca Cove on Herschel Island. The Peel Channel specimens ranged from 306 to 332 mm, the Herschel Island specimens from 43 to 355 mm in standard length.

Depth $4\frac{1}{2}$ to $5\frac{1}{2}$, head length $4\frac{1}{2}$ to $5\frac{1}{2}$ in standard length. Longest dorsal ray shorter than head length. Orbit less than three-quarters of interorbital width. Pectoral reaches half-way or less to origin of pelvic.

D 11-13; A 11-13; V 12-13; P 15-17; L.L. 85-100; G.R. 14-16 + 25-30=40-45; pyloric caecae 128 (in one specimen). Colour silvery, lacking the usual brassy tone of *nasus* and *clupeaformis*. Chin white. Interradial membranes of pelvics immaculate; those of the anal fin occasionally with a few melanophores. Mandible terminating opposite or slightly behind upper jaw. Upper lip curving down from snout. Scofield's (1899) *Argyrosomus lucidus* may be identified with this species. There appears to be little difference between this species and *artedi*.

Coregonus clupeaformis (Mitchill)**lake whitefish**

The lake whitefish was collected in Peel Channel 2 miles above Aklavik and in a stream 15 miles southwest of Aklavik. The six specimens varied from 40 to 459 mm in standard length.

Depth $2\frac{2}{3}$ to $3\frac{4}{5}$, head length $4\frac{1}{3}$ to 5 in standard length. Premaxillaries retrorse. Upper jaw extending to below front third of eye. Width of upper jaw 2.7 to 3.2 times its length. Nape concave in adults. Predorsal high and thin (razor-backed). Longest gill raker 40 to 56 times in standard length.

D 11-12; A 11-12; V 11-12; P 15-17; L.L. 78-86; Br 8-9; G.R. 7-9 + 16-17=24-25. Body colour of adults a brassy tone. Young without parr marks. Interradial membranes of fins dark. The 459 mm male with scattered white tubercles on side and top of head. A row of tubercles, one on each scale, on the five longitudinal rows of scales both above and below the lateral line; those on the lateral line scales reduced.

Coregonus nasus (Pallas)**broad whitefish**

The broad whitefish was collected in Peel Channel 2 miles above Aklavik; in streams 10 and 15 miles southwest of Aklavik. The six specimens ranged from 27 to 440 mm standard length. One was caught at Pauline Cove, Herschel Island, but not kept.

Depth 3 to $4\frac{2}{3}$, head length $4\frac{1}{3}$ to $4\frac{4}{5}$ in standard length. Premaxillaries vertical. Upper jaw ending before front of eye. Width of upper jaw 2.0 to 2.4 times its length. Nape convex, the profile of the head smoothly curving into the back predorsal region high and thin (razor-backed) in adults. Longest gill raker 56 to 71 times in standard length.

D 12; A 12-13; V 11-12; P 17-18; L.L. 82-86; Br 8-9; G.R. 7-8 + 13-14=20-22. Body colour of adults a brassy tone. Young without parr marks. Interradial membranes of fins dark. The head with scattered small tubercles and the centre of each scale, except those on the abdomen, with a small white tubercle (tubercles reduced on lateral line scales) on one large 440 mm male.

Stenodus leucichthys (Guldenstadt)**inconnu**

Specimens of inconnu were collected in Peel Channel at Aklavik and 2 miles above Aklavik. The 26 specimens ranged from 19 to 388 mm in standard length. A 23-pound inconnu was caught about two miles above Aklavik but not kept. Specimens of inconnu have been caught at Herschel Island (Walters, 1953) but were not obtained there by the present expedition.

Depth $5\frac{1}{3}$ to $5\frac{2}{3}$, head length $3\frac{1}{3}$ to $3\frac{3}{4}$ of standard length. Premaxillary antorse. Upper jaw long, extending back under posterior portion of eye in adults, its length exceeding depth of caudal peduncle. Predorsal region rounded.

D 12-13; A 14-15; V 11-12; P 16-17; L.L. 94-102; Br 10; G.R. 6-7 + 14-17=20-23. Colour of body silvery.

Currently the inconnu of the Arctic waters of Asia and North America are subspecifically separated from those in the Caspian Sea. Berg (1948) separates the two subspecies in his keys using gill-raker counts.—S. l.

leucichthys usually with 22 to 23 and *S. l. nelma* usually with 20 to 21 gill rakers. Counts of Aklavik area fish, 23, 23, 22, 21, 21, 20, 20, clearly cast doubt on subspecific separation on this basis. Neither do the counts of other authors on gill rakers indicate differences worthy of subspecific separation, although the range is slightly higher in the nominate subspecies. No other counts or measurements given by Berg, except possibly anal rays, support subspecific separation. Anal rays for *S. l. leucichthys* are 9 to 15, usually 12 to 13; for *S. l. nelma* 11 to 16, usually 13 to 16. Anal rays in our material of *S. l. nelma* were 14 to 15; Dymond (1943) gives 15 to 16 for Slave River (Great Slave Lake specimens), and Carl, Clemens, and Lindsey (1959) give 13 to 17 for B.C. specimens. The amount of overlap in anal ray counts would seem to be rather large to warrant subspecific separation. A more careful comparison is needed to justify separation of the two. Zenkovitch (1957) believes the Arctic relicts, which include *Stenodus*, entered the Caspian Sea 15,000 to 20,000 years ago.

OSMERIDAE

Osmerus eperlanus mordax (Mitchill)

smelt

Smelt specimens were caught at Simpson Point, Herschel Island. The four specimens varied from 234 to 257 mm in standard length; all were females.

Depth $5\frac{1}{2}$ to 6, head length $4\frac{1}{4}$ to $4\frac{1}{3}$ in standard length. Canines on vomer and tongue. Maxillary terminating about under the posterior border of the eye. Lateral line incomplete. Adipose ovate.

D 9-10; A 13-16; V 8; P 13-14; L.L. 20-23; midlateral scales 65-68; Br 7-8; G.R. 9-11 + 20-21 = 29-31; pyloric caecae 6-7. Colour in life, silver with purple iridescence; dark green dorsum. The systematics of this species are discussed in a manuscript revision of the family by the author.

Mallotus villosus (Muller)

capelin

The capelin specimens were seined at Pauline Cove and Simpson Point, Herschel Island. Some of these were sent to the Royal Ontario Museum and to the Institute of Fisheries, University of British Columbia. Specimens varied from about 110 to 135 mm standard length.

Depth $5\frac{2}{3}$ to $6\frac{1}{2}$, head length $4\frac{1}{3}$ to $4\frac{3}{4}$ in standard length. Maxillary reaching to below middle of pupil. No canine teeth. Males with enlarged lower fins and prominent lateral ridge.

D 11-12; A 18-21; V 8; P 16-19; G.R. 8-10 + 27-29 = 36-39.

Capelin were spawning on gravel beach when we arrived at Pauline Cove and Simpson Point on July 24 and continued until about July 30. In about eight hauls of a 60-foot seine around midnight July 29 to 30, capelin were so numerous that 1,500 to 1,600 pounds were caught.

ESOCIDAE

Esox lucius Linnaeus

northern pike

Northern pike were collected in a stream about 15 miles southwest and in a creek about 10 miles southwest of Aklavik. The specimens ranged

from 23 to 675 mm standard length. The catch of pike was reported to Hunter on a previous trip to Herschel Island.

Depth $5\frac{1}{2}$ to $6\frac{1}{2}$, head length 3 to $3\frac{1}{2}$ in standard length. Mandibular pores five. Hind margin of lip reaching middle of nostril. Cheek completely scaled, opercle scaled on dorsal half.

D 16; A 12-13; V 10-11; P 15-17; Br 14-15 (8 to 9 epihyal, 6 ceratohyal). Dark spots on median fins. Obliquely arranged rows of light spots across sides.

CATOSTOMIDAE

Catostomus catostomus (Forster)

longnose sucker

Longnose sucker specimens were collected in Peel Channel at Aklavik and 2 miles upstream from Aklavik. Specimens ranged from 53 to 388 mm in standard length.

Depth $4\frac{2}{3}$ to $5\frac{1}{2}$, head length $4\frac{1}{3}$ to $4\frac{2}{3}$ in standard length. Snout long, projecting. Lower left cleft with one row of papillae crossing cleft.

D 10-12; A 7; V 10-11; P 17-18; L.L. 106-115; 19-22 scales above the lateral line; G.R. 23-28. Peritoneum an evenly dispersed dark colour.

The lateral line counts would seem to place these specimens in the subspecies *rostratus* (104 to 127) rather than *catostomus* (90 to 117). The possibility that the scale counts are clinal with more scales on specimens to the northwest should be investigated. The present basis for subspecific recognition is not entirely adequate.

CYPRINIDAE

Couesius plumbeus (Agassiz)

lake chub

The lake chub was collected twice in the Peel Channel at Aklavik. Standard lengths ranged from 38 to 76 mm.

Depth $4\frac{2}{3}$ to $5\frac{1}{3}$, head length 4 to $4\frac{1}{3}$ in standard length. Length of depressed dorsal 1.22 to 1.44 times in distance from occiput to dorsal origin. Eye diameter exceeds snout length. A long barbel located just anterior to the end of the maxillary. Pharyngeal teeth 1, 4-4, 1 or 2.

D 8; A 7-8; V 8-9; P 17-18; L.L. 59-64. A dark mediolateral stripe on the posterior portion of the body sometimes extends anteriorly and continues along the snout. A thin, dark middorsal stripe.

Platygobio gracilis (Richardson)

flathead chub

The flathead chub was collected twice in the Peel Channel at Aklavik. Standard length ranged from 46 to 49 mm.

Depth $4\frac{1}{2}$ to $5\frac{1}{3}$, head length 4 in standard length. Barbel long, at end of maxillary. Head flat. Fins falcate. Pharyngeal teeth 2, 4-4, 2.

D 8; A 8; V 8; P 18; L.L. 55-57. A middorsal stripe and a midlateral stripe on the posterior portion of the body.

GADIDAE

Lota lota (Linnaeus)

burbot

Burbot were caught in a creek 10 miles southwest of Aklavik. The standard length of the 12 specimens varied from 75 to 130 mm.

Depth 7, head length $4\frac{1}{3}$ in standard length. Caudal peduncle length over its depth varied from 1.8 to 2.2 Mottled back, dorsal and caudal fins. Dark stripe along lower edge of anal fin. Lindsey (1956) is followed in not recognizing subspecies of burbot.

Boreogadus saida (Lepechin)

Arctic cod

The Arctic cod was the most ubiquitous species, being found in almost every marine collection. Specimens were caught at Simpson Point, Pauline Cove, and Orca Cove, Herschel Island; 3 miles southeast of Simpson Point; 7 miles northeast of Collinson Head, Herschel Island; at the southwest end of Herschel Island; 26 miles east of the Alaska-Yukon border. Specimens ranged from about 15 to 180 mm in standard length.

Depth $5\frac{1}{2}$ to $6\frac{1}{2}$, head length $3\frac{3}{4}$ to $4\frac{1}{2}$ in standard length. Orbit $3\frac{4}{5}$ to $4\frac{1}{3}$ in head length. Barbel minute, about one-third of pupil diameter. No palatine teeth. Some with stellate tubercles on sides.

D₁ 11-17; D₂ 13-16; D₃ 18-23; A₁ 16-18; A₂ 19-22; V 6; P 18-19; Br 7; G.R. 8-9 + 29-34 = 37-43; pyloric caecae 12-25. Peritoneum dusky.

Contrary to Walters (1953), Pfaff's fin ray counts for *Boreogadus* are considered to be within the ranges of that species and do not indicate the presence of *Arctogadus* in Pfaff's sample.

Johansen (MS.) examined purported specimens of *Pollachius virens* from Arctic Canada. These were all found to be *Boreogadus saida*. *Pollachius virens* may therefore be struck from the Arctic list, and its northern limit placed at Sandwich Bay, southern Labrador (Nfld. Fish. Res. Comm. Rept. 1932).

Eleginus gracilis (Tilesius)

saffron cod

The saffron cod was caught at Simpson Point and Pauline Cove, Herschel Island. These four specimens varied from 104 to 201 mm in standard length. A 290-mm specimen was caught July 25, 1952, at Tuktoyaktuk in the Mackenzie mouth by the writer's brother, Carey D. McAllister; the specimen is in the Institute of Fisheries, University of British Columbia collection (BC53-282).

Depth $5\frac{2}{3}$ to $6\frac{1}{3}$, head length $4\frac{1}{3}$ in standard length. Orbit $5\frac{1}{4}$ to $6\frac{1}{3}$ in head length. No palatine teeth. Sides smooth. Barbel small, its length about equal to diameter of pupil. The first parapophyses with swollen tips are the eighth to the tenth. The first 4 or 5 parapophyses are shortened. The first haemal arches lack wing-like, ventro-lateral projections. The tip of the lower jaw is posterior to the upper. Lateral line extends to beneath the anterior portion of the second dorsal before breaking up. Anterior projections of the gas bladder almost straight, not L-shaped.

D₁ 12-14; D₂ 17-21; D₃ 18-20; A₁ 20-23; A₂ 21; V 6; P 19-21; Br 7; G. R. 2-3 + 17-20 = 20-23; vertebrae 61 in two specimens; pyloric caecae 62 in one specimen (lies outside of count, 31 to 55, for *novaga*). Peritoneum light, speckled dorsally. Anterior portion of lateral line light. Dorsal and caudal fins white-edged; pectoral yellow; sides silver; back olive in life.

Since all the characters of these fish agree with *Eleginus gracilis*, as indicated by Svetovidov (1948), we identify our fish with that species. Gill-raker counts (20) indicate Pfaff's Simpson Strait specimen to be *E. gracilis*. However, Walter's (1955) specimens of *Eleginus* from Arctic

Canada and Alaska agreed with *E. navaga* in form and angle of the parapophyses, haemal arch, and colour (but with *gracilis* in gill-raker counts and number of normal parapophyses). He therefore reduced the species of *Eleginus* to subspecies and identified his specimens as *Eleginus navaga navaga*. However, even if the form of the parapophyses, haemal arches, and colour should not prove to be valid specific characters, the gill rakers and number of normal parapophyses remain and would seem to provide an adequate basis for specific separation. It is these latter characters that Svetovidov employs in his key to species of *Eleginus*. In this case Walter's material should be termed *E. gracilis*. The two species can thus be separated by gill rakers, *gracilis* with 14 to 23, *navaga* with 24 to 28; or by number of short parapophyses, *gracilis* with 2 to 5, *navaga* with 1. Thus, until specimens are again compared, the two forms are regarded as specifically distinct. Svetovidov, Berg, and Andriashev, all of whom have dealt with both forms, have accorded them specific distinction. Wilimovsky (1958) terms the Alaskan saffron cod *E. gracilis*, thus agreeing with the opinion presented here.

GASTEROSTEIDAE

Pungitius pungitius (Linnaeus)

ninespine stickleback

The ninespine stickleback was collected in a creek 10 miles southwest of Aklavik (33–46 mm) and in a brackish pond at the mouth of a rill in Pauline Cove, Herschel Island (8.3 to 56 mm in standard length).

Depth $4\frac{3}{4}$ to $5\frac{3}{8}$, head length $3\frac{1}{2}$ to 4 in standard length. Dorsal and pelvic spines of short type. Gill membranes united and free from isthmus. A lateral keel on the caudal peduncles. Up to two lateral line scutes.

D IX–X, 9–11; A 18–10; V 11; Br 3; G.R. $2-4 + 2-11 = 11-14$. Adults silver with yellow tail and dark green back in life.

PERCOPSIDAE

Percopsis omiscomaycus (Walbaum)

trout-perch

The trout-perch was collected in Peel Channel, Mackenzie River, at Aklavik. The 11 specimens varied from 38 to 57 mm in standard length.

Depth 4.6 to 4.7, head length 3.1 to 3.4 in standard length. Mouth ventral. Ctenoid scales. Adipose fin.

D II10–11; A 16–7; V 18; L.L. 45–47; Br 6; G.R. $2 + 7-8 = 9-10$. Pyloric caecae, ten in one specimen. Ten or eleven spots along middle of side.

AMMODYTIDAE

Ammodytes hexapterus Pallas

sand lance

The sand lance was collected at Pauline Cove and at the southwestern corner of Herschel Island. The three specimens varied from 63 to 72 mm in standard length.

Depth 12, head length $4\frac{2}{3}$ to $4\frac{3}{4}$ in standard length. Premaxillaries protractile. Stomach with long blind sac.

D 56–60; A 30; P 15–16; L.L. ca. 142–145; Br 7; G.R. $4 + 21 = 25$. Peritoneum sooty.

STICHAEIDAE

Lumpenus fabricii (Valenciennes)

slender eelblenny

The slender eelblenny was collected at the east end of Pauline Cove, Herschel Island. The 17 specimens preserved ranged from 70 to 159 mm in standard length.

Head length 5 to $6\frac{1}{3}$ in standard length. Orbit $4\frac{1}{2}$ to $5\frac{5}{8}$ in head length. Gill membranes joining posteriorly to eye. No palatine or vomerine teeth. Pectoral rays not projecting beyond membrane. Dorsal and anal adnate to caudal.

D 62-65 spines; A 140-43; V 13; P 14-16; Br 6; G.R. 12-16. Peritoneum silvery below, dark above. Body yellowish with dark mottlings on back and snout. Short horizontal bars on lower side, dorsal spines black-tipped, caudal with transverse bars.

Specimens from near Churchill, Hudson Bay, have a larger head, 4.7 to 5.5 in standard length; a larger eye, 3.6 to 4.5 in head length; more pectoral rays, 15 to 17; and more gill rakers, 14 to 17, than Herschel Island or Alaskan specimens. The Hudson Bay specimens also have a larger eye than those shown in illustrations of a specimen from Greenland and Chukchi Sea. Further samples are required before these differences are evaluated.

ZOARCIDAE

Lycodes pallidus Collett

pale eelpout

The pale eelpout was collected 3 miles southeast of Herschel, Herschel Island. The specimen was 114 mm in total length.

Head length 20 per cent, depth at anal origin 7.1 per cent, pectoral length 14.7 per cent, preanal length 42 per cent, and orbit 3.7 per cent of total length. Four sharp vomerine and eight palatine teeth. All the sides to the bases of the vertical fins scaled; abdomen naked. A short ventral lateral line anteriorly.

D $+$ $\frac{1}{2}$ C 94; A $+$ $\frac{1}{2}$ C 85; P 16; Br 6; pyloric caecae 2. Nine light-brown wide bands across sides and dorsal fins separated by narrow light bands which merge on the light ventre. A light oval predorsal spot and a narrow light nuchal band. Peritoneum speckled with black.

Lycodes rossi Malmgren

Lycodes rossi was collected 7 miles northeast of Collinson Head, Herschel Island. The two specimens were 97 and 165 mm respectively in total length.

Head length 22.8 to 24.8 per cent, depth at anal origin 10.9 to 11.0 per cent, pectoral length 14.0 to 14.4 per cent, preanal length 44.8 to 49.6 per cent of total length. Two sharp vomerine teeth. Sides scaled up to tip of pectoral fin; ventral naked. A mediolateral and a widely spaced dorso-lateral and predorsal lateral line.

D $+$ $\frac{1}{2}$ C 92; A $+$ $\frac{1}{2}$ C 76; P 19; pyloric caecae 2. Eight to nine light bars across side and dorsal fin. The anterior light bars in the large specimen cease at the lateral line. The brown bars between with dark edges and

light centres. The nuchal bar broken into three, dark-rimmed light spots. A dark-rimmed light spot above the jaw and in front of the preoperculum of the large specimen. Peritoneum immaculate.

These specimens, if correctly identified, represent a range extension of over 2,000 miles. They were known from Kara Sea and Spitsbergen. The three nuchal spots, pectoral ray count, absence of reticulations depth, and shape of the tip of the operculum agree with *rossi*. The length of the pectoral fin, on the other hand, agrees with the closely related species *reticulatus*, rather than *rossi*. A closer comparison is needed between these species.

Lycodes jugoricus Knipowitsch

shulupaoluk

Shulupaoluk was collected between Herschel and Collinson Head, Herschel Island, and 3 miles southeast of Herschel, Herschel Island. The specimens were 133 and 161 mm in total length.

Head length 23.0 per cent, depth at anal origin 8.9 to 9.1 per cent, pectoral length 15.5 to 16.0 per cent, preanal length 45.8 to 47.9 per cent, and orbit 3.6 to 4.3 per cent of total length. Twelve low rounded vomerine teeth, six to nine palatine teeth. Scales absent. A mediolateral and a widely spaced dorsolateral and predorsal lateral line.

D + $\frac{1}{2}$ C 100-101; A + $\frac{1}{2}$ C 78-81; P 17-18; Br 6; pyloric caecae 2. Seven or eight dark wedge-shaped markings across back and dorsal fins. These taper ventrally and have light centres. The predorsal region and head is dark, there being no nuchal stripe. Peritoneum immaculate.

This is the first record of this species from Canada and from the Beaufort Sea. Wilimovsky in Walters (1955) has collected what is apparently this species from the Chukchi Sea. The numerous round-topped vomerine teeth positively identify this species. Walters (1955) suggests that Sabine had this species when he described *Blennius polaris* from Arctic Canada. But *jugoricus* has seven to nine dark saddles across the back instead of 11, and the pectoral rays of *jugoricus* number 17 to 18 instead of 15. Therefore *polaris* and *jugoricus* are considered distinct from one another.

Shulupaoluk is a name applied by Ungava Eskimos to an eelpout (Dunbar and Hildebrand, 1952).

Lycodes polaris (Sabine)

Canadian eelpout

The Canadian eelpout was collected between Herschel and Collinson Head, Herschel Island, and 3 miles southeast of Herschel, Herschel Island. The seven specimens ranged from 63 to 197 mm total length.

Head length 20.5 to 24.4 per cent, depth at anal origin 8.4 to 9.6 per cent, pectoral length 10.6 to 12.7 per cent, preanal length 47.0 to 51.2 per cent, orbit 3.6 to 4.5 per cent of total length. Two to four sharp vomerine and seven to ten palatine teeth. Scales absent. A mediolateral and a widely spaced dorsolateral and predorsal lateral line. Premaxillary teeth opposite the first palatine teeth.

D + $\frac{1}{2}$ C 89-92; A + $\frac{1}{2}$ C 70-74; P 15-17; Br 6; pyloric caecae 2. Nine to eleven dark saddle-shaped bars across back and dorsal fin. These have a light centre. The edge of the saddles is less well defined than that in *rossi*, since a darker edge is absent. The light nuchal band is dark-edged and usually separated into three spots. Peritoneum immaculate.

The author concurs with Andriashev (1954) and Wilimovsky (1958) that this species should be called *Lycodes polaris*. *Lycodes turneri*, which Walters has applied to this species, is distinguished from *polaris* by its fewer vertical fin rays, D 85-86, A 67 (including $\frac{1}{2}$ C) and more numerous pectoral rays, 18, as well as the dark-edged bars crossing its back. The original description of *polaris*, though poor, nevertheless contains the following salient characteristics: with pelvics, lacking scales (even under microscope), though of sufficient size to have developed them; 15 pectoral rays and 11 large, saddle-shaped, dark brown markings across the back. These characters distinguish it from all other Arctic scaleless *Lycodes* and apply to the form under consideration. *Lycodes agnostus* Jensen is a synonym of *polaris*.

Vladykov and Tremblay (1936) described an eelpout from Eastern Canada as *Lycodes turneri atlanticus*. Their eelpout has more numerous dorsal rays (87 to 94) as compared to 85 of *turneri* Bean,¹ more anal rays (72 to 75) as compared to 67; and a larger eye, 4.3 to 5.4 per cent of the total length as compared to 2.6 per cent. Thus the Eastern Canadian form of *turneri* seems to be different from the Alaskan *turneri* described by Bean. On the other hand, when one compares *polaris* with *turneri atlanticus*, one finds only slight differences. The fin ray counts are almost identical, and the proportions of the head, pectoral fin, and preanal lengths are very close. The eye of *polaris*, 2.7 to 4.5 per cent, tends to be smaller than the eye of *turneri atlanticus*, 3.9 to 4.2 per cent, and the head and pectoral are very slightly larger, 1 to 2 per cent. Comparison of a specimen of *turneri atlanticus* from the estuary of the St. Lawrence and *polaris* specimens from Herschel Island shows that the colour patterns are very similar. It is thus possible that *turneri atlanticus* is a synonym of *polaris*. This requires further study. But whatever the affinities of Vladykov and Tremblay's form, their species-group name *atlanticus* is preoccupied by *Lycodes atlanticus* Jensen 1904. It may also be pointed out that *polaris* is very close to *mucosus*.

COTTIDAE

Artediellus scaber Knipowitsch

hamecon

The hamecon was collected between Simpson Point and Collinson Head, Herschel Island, $1\frac{1}{2}$ miles south of Simpson Point, and 26 miles west of the Alaska border. The 27 specimens ranged from 25 to 62 mm in standard length. (See Figure 2 for a sketch of a specimen.)

Depth $3\frac{3}{4}$ to $4\frac{1}{4}$, head length $2\frac{2}{3}$ to $2\frac{5}{8}$ in standard length. A cirrus on end of maxillary, two before upper preopercular spine, often on the operculum and one on the postorbital and one on the occipital spine. Palatine and vomerine teeth present. Top of head and eyes with papillae. Small conical tubercles on nape, on first portion of lateral line and in row along back. Axil bare. Nasal spines absent. Median chin pore.

D₁ VIII-IX; D₂ 12-14; A 11-13; V 13; P 19-21; L.L. pores 23-28; Br 6; G.R. 0 + 3-5; pyloric caecae 3-4. Specimens ripe. Males with

¹ Thanks to Dr. L. P. Schultz, the holotype of *turneri*, U.S.N.M. 21529, was examined at the U. S. National Museum. The dorsal ray count of ca. 92 and the anal ray count of 69 (both including half the caudal rays) indicate that *turneri* may not be so distinct as the literature indicates. X-rays are needed for an accurate count.



FIGURE 2. Drawing of the hamecon, *Artediellus scaber*.

elongated spinous dorsal bearing oval dark spot in posterior portion; orange bands on all fins; prominent large orange round spots on sides; tips of pectoral rays white, rest of rays dark. Roof of mouth dusky.

These specimens constitute the first positive record of this species for Canada. Johansen (MS.) recorded *Artediellus pacificus* from Dolphin and Union Strait west of Cockburn Point, N.W.T. These Walters has interpreted as *Artedius* (*lapsus culumni* for *Artediellus*) *dydmovi* or *Artediellus atlanticus*. Comparison of Johansen's detailed colour description with specimens of *scaber* of similar size leads one to suspect they are that species, so close is the agreement, contrary to Walters.

This species, lacking a common name in the American Fisheries Society list, is called hamecon, from the French *l'hameçon* meaning hook, referring to its hook-shaped preopercular spine.

A 27-mm specimen of this species from Kotzebue Sound, Alaska, collected by R. Bartlett, 12 to 17 fathoms, summer 1924, is in the National Museum of Canada. It has cirri in the nape and back, 25 lateral pores, no nasal spines, and 11 anal rays.

***Cottus ricei* (Nelson)**

spoonhead sculpin

The spoonhead sculpin was caught in Peel Channel, Mackenzie River, at Aklavik. The specimen was 26 mm in standard length.

Head length $3\frac{1}{5}$ in standard length. A median chin pore. Strong prickles on nape, sides, caudal peduncle, and even a few on the abdomen. Head, wide and flat. Four preopercular spines, the upper incurved. Preorbital bones projecting out over maxillary give the upper profile of the snout a W-shape. Lateral line behind pectoral descending to a mediolateral position, without a deflection on the caudal peduncle.

D₁ IX; D₂ 17; A 12; V 14; P 15; Br 6. Speckled with small brown spots.

***Gymnocanthus tricuspis* (Reinhardt)**

Arctic staghorn sculpin

An Arctic staghorn sculpin was collected at the southwest end of Herschel Island; 26 miles east of the Alaska border; 3 miles southeast of Herschel, Herschel Island; $1\frac{1}{2}$ miles south of Simpson Point, Herschel Island. The 158 specimens ranged in standard length from 35 to 102 mm.

Head length $2\frac{2}{5}$ to $3\frac{1}{4}$ in standard length. Granular plates on occiput; none or one in the middle of the interorbital region. Back bare; axil with

ctenoid scales. Upper preopercular spine long, with one to three spinules. Vomer and palatines without teeth. No parietal spines. None, one, or sometimes two small frontal spines.

D_1 X-XII; D_2 14-15; A 16-18; V I3; P 17-19; L.L. pores 38-43; Br. 6; G.R. $0-2 + 5-9 = 6-10$; pyloric caecae 4-5. Ventral portion, a flat white colour. Lower sides with dark spots. First dorsal and tips of pectoral with three dark bars, red-brown in life. Second dorsal with four to five bars. Roof of mouth pale. Sides with red-brown speckles. Male specimens have the ventral fins extending to or past the anus, whereas in the females they are short of the anus. The ventrals of the male have pink and white bars; those of the female are plain. Males possess a long conical genital papilla extending past the anal origin.

Eastern Arctic and Atlantic Canadian specimens were always found to have a frontal spine and usually an accessory spine or two, or even three. The frontal spine in specimens from the Herschel area is poorly developed and sometimes absent, and there is rarely an accessory spine. The dorsal rays, 15 to 17, of Eastern Arctic and Atlantic specimens tended to be more numerous. No Canadian specimens with the club-shaped filaments in the axil (*G. pistilliger*) have been found.

***Icelus bicornis* (Reinhardt)**

twohorn sculpin

The twohorn sculpin was collected 7 miles northeast of Collinson Head, Herschel Island. The 17 specimens varied from 38 to 58 mm in standard length.

Head length 2.6 to 2.7 times in standard length. Usually a parietal cirrus. A postorbital cirrus present. A row of spiny plates along the back; above these, small granular scales. Spiny axillary plates behind the pectoral; in the uppermost row of these below the lateral line are five to eight plates. Two symphysial chin pores. Palatine and vomerine teeth are present. A spine at the caudal fin base below the lateral line. Spines on the lateral line scales below the pores. Frequently a row of spines beside the anal fin. The lateral line, always incomplete, dropping to midlateral position under the beginning of the second dorsal.

D_1 IX-X; D_2 19-21; A 14-15; V I3; P 16-18; L.L. 33-37; G.R. $1-2 + 7-11 = 8-11$. Brown spots scattered over whole body. Male genital papilla with a long conical terminal portion which is in line with the basal portion.

***Icelus spatula* Gilbert and Burke**

spatulate sculpin

The spatulate sculpin was caught $1\frac{1}{2}$ miles south of Simpson Point; 3 miles southeast of Herschel, Herschel Island; and 7 miles northeast of Collinson Head. The eight specimens varied from 29 to 71 mm in standard length.

Head length 2.7 to 2.9 times in standard length. A postorbital but no parietal cirrus. A row of spiny plates along the back; above these are small granular scales. Spiny axillary plates behind pectoral; in the uppermost row of these below the lateral line there are 0 to 5 plates. Two symphysial chin pores. Vomerine and palatine teeth. No spine at caudal fin base below lateral line nor spines on the lateral line scales below the pores. Never spines beside the anal fin base. The lateral line dropping to midlateral position under the beginning of the second dorsal; often incomplete.

D₁ IX-X; D₂ 19-20; A 15-16; V I3; P 17-19; L.L. 41-44 (in adults over 45 mm). Brown spots scattered over body. Roof of mouth pale. Male genital papilla with a short hooked tip.

***Myoxocephalus quadricornis* (Linnaeus)**

fourhorn sculpin

The fourhorn sculpin was collected at numerous stations; Simpson Point, Herschel Island; Pauline Cove, Herschel Island (in cove and in brackish ponds) half a mile east of Herschel, Herschel Island; 3 miles southeast of Herschel; southwest Herschel Island; 3 miles southeast of Herschel; 26 miles east of Alaskan border; Ptarmigan Bay, southeast of Herschel Island on mainland; Thetis Bay, Herschel Island. A large male (red under head) was netted, but lost, from 20 fathoms, east of Osborn Point, Herschel Island; this is the deepest record for this species in Canada. Specimens collected varied from 16 to 173 mm in standard length.

Head length $3\frac{1}{8}$ to $3\frac{1}{3}$ in standard length. Four preopercular spines. No palatine teeth. Caudal peduncle narrow. Head flat with four rough-topped spines.

D₁ VIII-IX; D₂ 13-15; A 13-15; V I3; P 16; L.L. 34-39; dorsal stellate tubercles 45-105; ventral stellate tubercles 11-75; Br 6; G.R. 1 + 5-7 = 6-8; pyloric caecae 7-9. In life, back a mottled brown; pelvics, lower jaws, and branchiostegal membrane, lower pectoral and first anal rays pink in male, white in female. Characters of these specimens confirm the distinctions between *M. quadricornis* and *M. thompsonii* (McAllister, 1960).

***Myoxocephalus scorpioides* (Fabricius)**

Arctic sculpin

The Arctic sculpin was collected only once, at Simpson Point, Herschel Island. The single female specimen measured 104 mm in standard length.

Head length three times in standard length. Caudal peduncle depth $4\frac{4}{5}$ times in head length. Head between gill covers and eyes densely covered with papillae, those between eyes forming rows. Frontal and parietal spines single, low, skin-covered, each with a short, stout cirrus. Two chin pores. No palatine teeth. Round spiny plates on back above lateral line, extending anteriorly to nape, 49 in number. Twenty-two spines below the lateral line under the second dorsal.

D₁ X; D₂ 16; A 12; V I3; P 15; L.L. 39; Br 6; G.R. 1 + 4 = 5; pyloric caecae 5. Roof of mouth pale. Pelvics with two cross bars. Anal, soft dorsal, and caudal with stripes. White spot on base of tail. A dark bar across the caudal peduncle and two under the soft dorsal. Underside of mandible dark.

This specimen agrees well with descriptions of *Myoxocephalus axillaris* which Walters (1955) synonymizes with *M. scorpioides*. Almost all the National Museum specimens from the eastern Canadian Arctic lack the spiny plates above the lateral line. No other difference between those with or without these plates could be found, however. According to Andriashev (1954), the plates are found only on larger specimens.

***Triglops pingelii* Reinhardt**

ribbed sculpin

The ribbed sculpin was collected 7 miles northeast of Collinson Head, Herschel Island; east end of Pauline Cove, Herschel Island; 26 miles east

of the Alaskan border; between Collinson Head and Herschel, Herschel Island; 3 miles southeast of Herschel; $1\frac{1}{2}$ miles south of Simpson Point, Herschel Island. The 26 specimens ranged from 49 to 110 mm in standard length.

Head length 3.3 to 3.7 in standard length. Depth of caudal peduncle 2.9 to 3.5 (3.8) per cent of standard length. Diameter of orbit less than postorbital length of head. Premaxillaries not steep, forming acute angle with bottom of head, 48 to 57 degrees. Innermost pelvic ray longest. No palatine teeth. Serrated oblique folds of skin below the lateral line and similar folds on breast before the pelvics. Males with a forwardly directed, carrot-shaped genital papilla. Lower pectoral rays exerted.

D₁ X-XII; D₂ 23-26; A 23-25; V 13; P 18-19; L.L. 48-50; Br 6; G.R. 0 + 5-8; pyloric caecae 4-6. Roof of mouth pale. Caudal fin without bars. No dark spot on posterior spinous dorsal. Back a light brown with dark marks; underside white in life. *Triglops beani* Gilbert should be considered a synonym of *T. pingelii* as indicated by Andriashev (1954).

CYCLOPTERIDAE

Liparis herschelinus Scofield

bartail snailfish

The bartail snailfish was collected between Collinson Head and Herschel, Herschel Island; 26 miles east of the Alaskan border. The twelve specimens varied from 45 to 115 mm in standard length.

Depth 4.3 to 5.0, head length 3.4 to 3.7 in standard length. Disc 2.1 to 2.6, eye 5.0 to 7.0 in head length. Gill slit extending down to opposite the second or third pectoral ray. Dorsal connected to caudal for about one-quarter its length.

D 40-42; A 34-36; P 33-36; Br 6; G. R. 0 + 6-10; pyloric caecae 17-24. Peritoneum pale with a few speckles dorsally. Fins usually slightly mottled. Posterior body spotted or variegated. Caudal base pale. Behind base a distinct wide dark bar, behind which is sometimes a second narrow bar. The specimen from 26 miles east of the Alaskan border, the only one caught among kelp, was a kelp-brown colour with golden iris when alive; the other specimens were a grey-brown in life.

The well-preserved present series of specimens, being topotypic, enable solution of some systematic questions. Burke (1930) was not certain that this species was distinct from *L. tunicatus*. Examination shows that, although the ray counts are identical, the number of pyloric caecae easily distinguishes the two—17 to 24 in *herschelinus* and 30 to 35 in *tunicatus* from Eastern Canada. Thus, *herschelinus* should be regarded as a distinct species from *tunicatus*. Walters (1953) considered *herschelinus* as probably identical to or at best, a subspecies of *L. liparis*. However, *L. liparis* according to Burke (1930) and Poll (1947) has 27 to 29 anal rays, to Parr (1932) 29 to 34 anal rays; whereas *herschelinus* has 34 to 36 anal rays. So for the moment, until specimens are actually compared, *herschelinus* is regarded as distinct from *liparis* on the basis of anal counts.

Figure 263 in Andriashev (1954) (from Popov, 1933), captioned *L. liparis*, appears from the colour and fin-ray counts to be *L. herschelinus*. If so, this record would extend the distribution of *herschelinus* west to the Laptev Sea. Wilimovsky (1960) recognized *herschelinus* from Arctic Alaska.

It is difficult to compare *herschelinus* with the species in Parr's (1932) review since he omitted pectoral ray and pyloric caecae counts.

Liparis koefoedi Parr

gelatinous seasnail

The gelatinous seasnail was collected 7 miles northeast of Collinson Head, Herschel Island; 3 miles southeast of Herschel, Herschel Island; $1\frac{1}{2}$ miles south of Simpson Point, Herschel Island. A specimen about $1\frac{1}{2}$ inches long was caught pelagically in a stramin net hauled at 70 feet (non-closing type) over deep water east of Herschel, Herschel Island. Placed in an aquarium, it swam about, off the bottom. The 24 specimens varied from 54 to 106 mm in standard length.

Depth 3.6 to 4.0, head length 3.3 to 3.7 in standard length. Disc 2.3 to 2.7, orbit 4.1 to 5.0 in head length. Head 25 to 28 per cent, tail 70 to 74 per cent, caudal fin 12 to 14 per cent, and disc 12 to 13 per cent of total length. Gill extending down to opposite 5th to 8th pectoral ray. Dorsal connected to caudal for about a third of its length.

D 45-47; A 37-40; P 36-37; Br 6; G.R. 0 + 6-8; pyloric caecae 18-25. Body yellow-white in preserved specimens. Median fins transparent with dark crossbars in young. In adults cross bands less distinct because melanophores develop between the bands. The large male 106 mm in standard length with prickles between the eyes, on occiput, nape, and gill covers.

The characters of these specimens are divided between the Spitsbergen and non-Spitsbergen forms in Backus's (1957) key. It seems likely, as he suggested, that this species breaks up into local populations morphometrically different. On the other hand, preservation differences might account for the morphometric differences found in different samples of this gelatinous organism.

Liparis laptevi from Tainnir, Arctic U.S.S.R., agrees with *koefoedi* in ray counts and eye and disc size. It seems likely that *laptevi* was based on a specimen of *koefoedi* lacking the usual black peritoneal coloration.

AGONIDAE

Aspidophoroides olrikii Lütken

Arctic alligatorfish

The Arctic alligatorfish was collected 7 miles northeast of Collinson Head, Herschel Island. The four specimens varied from 37 to 58 mm in standard length. The three adults were females.

Depth $5\frac{3}{4}$ to $6\frac{1}{2}$, head length $3\frac{3}{4}$ to 4 in standard length. Nasal spines present. Maxillary barbel. One dorsal fin. Plates of adults not spinous.

D 5-7; A 5-6; V 12; P 14-15; dorsal plates 35-40; lateral plates 37-41; Br 6; G.R. 0 + 6-9; pyloric caecae 3-4. Dark bar running through snout, continuing on operculum. Dark spot above pectoral. Back and head brown in life. Dorsal fin with vertical dark bar. The pelvics are short in the three adults, being shorter than the postorbital distance, as is characteristic of females. The 53-mm specimen contained apparently ripe eggs of 1.6 mm diameter.

These specimens seemingly constitute the first record for the Beaufort Sea.

PLEURONECTIDAE

Liopsetta glacialis (Pallas)

Arctic flounder

The Arctic flounder was collected at Pauline Cove and Orca Cove, Herschel Island. The specimens ranged from 59 to 185 mm in standard length.

Depth 1.8 to 2.2, head length 3.6 to 3.9 in standard length. Pectoral length 1.5 in head in males, 1.9 to 2.2 in females. Body with ctenoid scales, often on gill cover, and in the male, between the eyes. Dental formula

$$\begin{array}{r} 3+15 \\ \hline 5-6+17-18 \end{array}$$

Dextral. Lateral line rising little above the pectoral fin; a supratemporal branch without posterior prolongation. Interhaemal spine in front of anal fin.

D 57-64; A 41-46; V 6; P 10-12; L.L. 73-79; G.R. 2-4 + 7-8 = 9-12; pyloric caecae 2. Peritoneum of blind side silver, dusky posteriorly; of eyed side black. Young, spotted on fins and eyed side; blind side white. Adults, dark brown on eyed side, fins unmarked; blind side white.

Norman, in his monograph of the flatfishes, was uncertain whether *Liopsetta glacialis* was specifically distinct from *L. putnami*, although he treated them as full species. The differences in head length that he noted are substantiated by comparison with an adult *putnami* from Atlantic Canada. The difference in pectoral fin length does not appear so great as he indicated. The pharyngeal teeth of *putnami* are wider than those of *glacialis*, as he observed. Nine specimens of *putnami* from Quebec and New Brunswick had 65 to 72 lateral line scales; whereas in *glacialis* (our specimens and literature) they number 73 to 100. The difference possibly may not hold for more northerly specimens of *putnami*. The one adult specimen of *putnami* had black peritoneum on the blind side, but all *glacialis* examined had silver peritoneum, except for a dusky streak posteriorly. Because of all these differences, *glacialis* is, for the moment, considered specifically different from *putnami*.

FAUNAL RELATIONSHIPS OF HERSCHEL ISLAND

Herschel Island may be classified faunistically by studying the distribution of its fish. Areas sharing major portions of its fauna may be judged to be in the same faunal region. Figure 3 shows the number, out of 29, of the Herschel Island fishes found in adjacent seas. *Esox lucius* is omitted from this discussion, since it is unable to disperse through brackish or salt water.

Generally speaking the character of the fauna is low Arctic. Only ten of the species reach the high Arctic waters of the Queen Elizabeth Archipelago or Spitsbergen, but 20 species reach the waters of the Atlantic (Labrador and Norway southwards) or Pacific (south of Bering Sea). Most of the elements thus seem to be southern. The northern fauna, however, contributes proportionally more than the indicated number since there are fewer species to the north than to the south. The actual situation is not quite so simple as might be suggested. The upper waters about



FIGURE 3. A polar view showing the number (out of 29) of Herschel Island species found in other seas. Note the seas of the Palaearctic have more species in common than the Eastern Arctic.

Herschel Island are warmer and fresher, and contain the southern species such as *Clupea harengus pallasii* and *Osmerus eperlanus mordax*, while the deeper, cooler, more saline waters contain the more northerly species such as *Liparis koefoedi* and *Icelus bicornis*.

Despite the nearness of Herschel Island to the Pacific, nearly as many of the Herschel Island species reach the Atlantic as the Pacific. Seventeen Herschel species reach the Atlantic, while 23 reach Bering Sea and 10 extend south into the Pacific itself. Generally, Bering Sea is considered part of the Pacific. MacGinitie (1955) found a very similar relationship with the invertebrates at Point Barrow, Alaska. In the invertebrates 19 per cent were common with the Atlantic, and 22 per cent were common with the Pacific.

In Eastern Arctic Canada (east of Boothia Peninsula—see Figure 4), the proportion of Atlantic forms is naturally higher. One might expect the faunistically rich Pacific to have contributed more to the Arctic fauna.

The relatively high contribution of the Atlantic to the Arctic fauna may be attributed to the wide connection of the Atlantic with the Arctic and to their oceanographic similarity, as compared to the narrow or formerly closed connection with the Pacific and the oceanographic dissimilarity of the Pacific and Arctic (McAllister, 1960a).

The most striking fact discernible from the map in Figure 3 is the great number of forms shared by the Arctic seas to the west of Herschel, compared with the few forms shared by Eastern Arctic Canada. The closest sea to the west, Chukchi Sea, shares 28 forms, and the farthest sea to the west, the Barents-White Sea, shares but a few less, 25 forms. On the other hand, the Eastern Arctic shares only 14 species with Herschel Island. Although the Eastern Arctic is much closer, it shares many fewer forms with Herschel than does the Barents-White Sea. It would thus appear that there is a fairly distinct fauna which extends eastward from the Barents-White Sea and ceases in the central Canadian Arctic. This fauna is here named the *Innuvit fauna*. The Innuvit fauna appears to be blocked to the east by a barrier in the central Canadian Arctic. Many appear to drop out at Cape Bathurst, most at Bathurst Inlet, and a few as far east as Queen Maud Gulf, just before Boothia Peninsula. Although the central Canadian Arctic is not well studied, the Boothia Peninsula region is indicated to be the barrier to eastward dispersal.

The effectiveness of the barrier may be judged by the fact that at least 12 forms are unable to reach past it to the Eastern Arctic or the

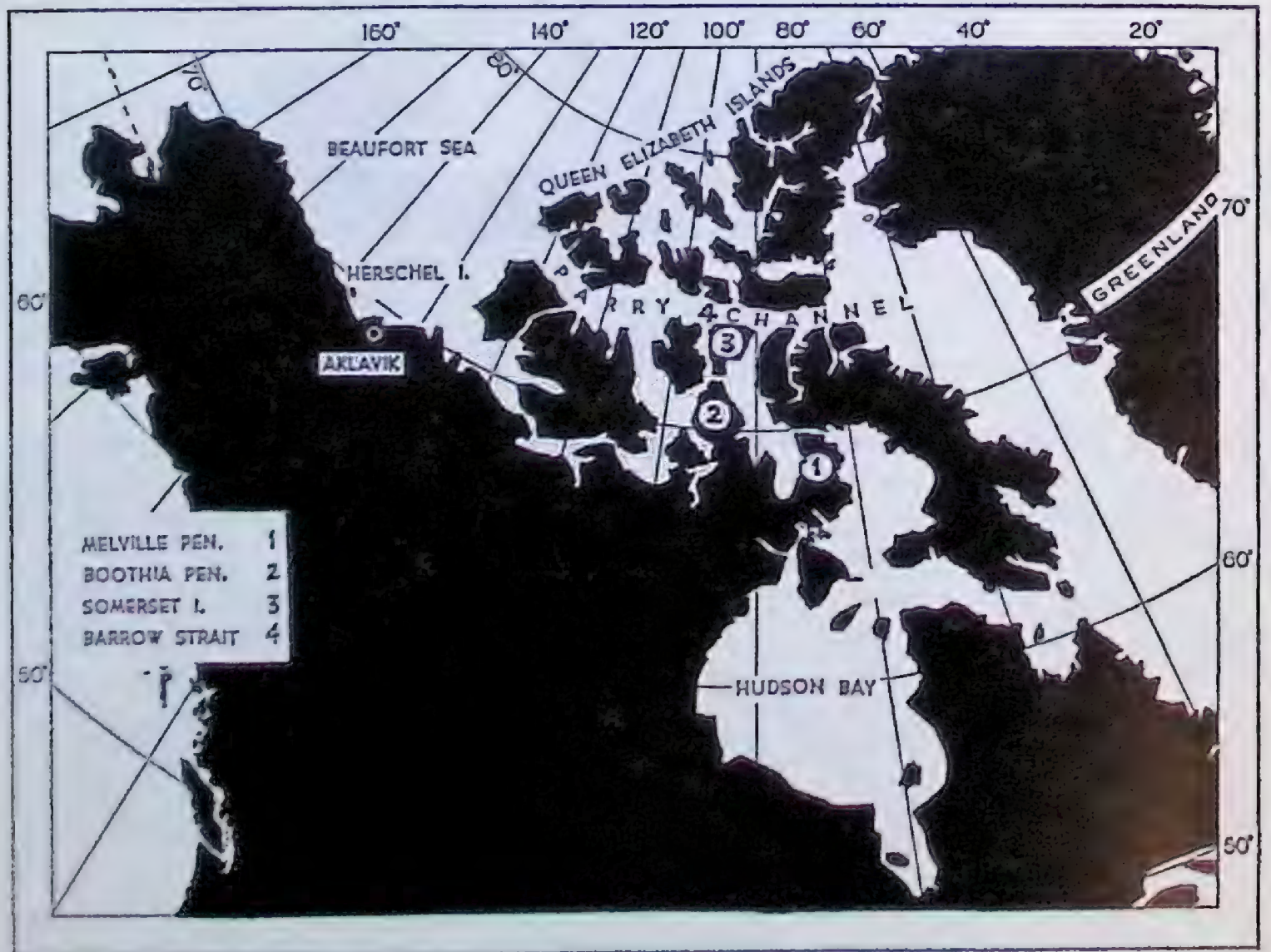


FIGURE 4. Arctic Canada showing localities mentioned in text.

western North Atlantic. Examination of possible ecological factors indicates that temperature, salinity, or ice may be involved in the barrier. Mean summer temperatures from Queen Maud Gulf to Barents Sea are usually 37°F or higher, mean salinities 28–29‰ or less, and ice coverage one-tenth or less (U.S. Navy Hydrographic Office, 1958). That is, the Inuit fauna lives in a relatively warm, brackish, iceless habitat in summer. These conditions are partly mediated by the influx of warm water from the large southern rivers. But in the region of Boothia Peninsula and in the Eastern Arctic, the mean summer temperatures are generally 35°F or less, mean summer salinities 30‰ or more, and ice coverage more than one-tenth. This area is thus colder, more saline, and ice covered in summer. Winter conditions are little known, but because of the higher salinities of the Boothia Peninsula area and eastward, winter temperatures probably descend lower.

Thus it seems plausible that eastward dispersal of Inuit fauna past the central Canadian Arctic is prevented by low temperature, high salinity, or extensive ice cover, or some combination of these factors.

SUMMARY

Thirty species of fish from the Herschel Island area, Yukon Territory, and fourteen from Aklavik, N.W.T., Canada, are reported on in this paper. Descriptive and taxonomic comments are made on each species. *Artediellus scaber*, *Lycodes jugoricus*, and *L. rossi* are reported from Arctic Canada for the first time. *Aspidophoroides olrikii* is recorded for the first time from the Beaufort Sea. Additional diagnostic characters for *Coregonus sardinella* and *C. autumnalis* are given. Doubt is cast on recognition of subspecies of *Stenodus leucichthys*. The Canadian species of *Eleginus* is indicated to be *gracilis* rather than *navaga*. Confirmation is obtained that *Liparis herschelini* is distinct from *L. tunicatus*. Evidence is found in favour of regarding *Liopsetta glacialis* as a species distinct from *L. putnami*. Other genera commented on are *Entosphenus*, *Clupea*, *Salvelinus*, *Osmerus*, *Mallopus*, *Esox*, *Catostomus*, *Couesius*, *Platygobio*, *Lota*, *Boreogadus*, *Pungitius*, *Percopsis*, *Ammodytes*, *Lumpenus*, *Cottus*, *Gymnocanthus*, *Icelus*, *Myoxocephalus*, and *Triglops*. Herschel Island fish are considered to belong to the Inuit fauna, a low Arctic fauna which stretches along the coast from Boothia Peninsula, Canada, to Barents Sea, Europe.

RÉSUMÉ

La présente communication traite de trente espèces de poissons des eaux voisines de l'île Herschel (Yukon) et de quatorze autres espèces des parages d'Aklavik (T.N.-O.), au Canada. Chaque espèce fait l'objet d'observations descriptives et taxonomiques. C'est la première fois que sont signalées dans l'Arctique canadien les espèces *Artediellus scaber*, *Lycodes jugoricus* et *L. rossi*. *Aspidophoroides olrikii* est aussi signalé pour la première fois dans la mer de Beaufort. De nouveaux caractères distinctifs de *Coregonus sardinella* et de *C. autumnalis* s'ajoutent aux caractères déjà connus de ces espèces. L'identification d'une sous-espèce de *Stenodus leucichthys* soulève certains doutes. Certaines observations donnent à croire que l'espèce canadienne d'*Eleginus* est *E. gracilis* plutôt qu'*E. navaga*. D'autres observations confirment que *Liparis herschelini* est une espèce distincte de *L. tunicatus*. Certains détails permettent de croire que *Liopsetta glacialis* est une espèce distincte de *L. putnami*. D'autres observations portent sur les genres *Entosphenus*, *Clupea*, *Salvelinus*, *Osmerus*, *Mallotus*, *Esox*, *Catostomus*, *Couesius*, *Platygobio*, *Lota*, *Boreogadus*, *Pungitius*, *Percopsis*, *Ammodytes*, *Lumpenus*, *Cottus*, *Gymnocanthus*, *Icelus*, *Myoxocephalus* et *Triglops*. Les poissons des parages de l'île Herschel sont censés appartenir à la faune Inuit du sud de l'Arctique, faune qui fréquente les eaux côtières de la presqu'île de Boothia, au Canada, jusqu'à la mer de Barentz, en Europe.

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THE DISAPPEARANCE OF THE QUEEN CHARLOTTE ISLANDS' CARIBOU

BY A. W. F. BANFIELD

The Queen Charlotte Islands' caribou (*Rangifer tarandus dawsoni* Seton, 1900) is one of the least known Canadian mammals. Its discovery was unexpected—only a handful of people ever saw the animal alive—and its disappearance is a matter of conjecture.

The animal was first reported by Dr. G. M. Dawson of the Geological Survey of Canada after his geological exploration of the Queen Charlotte Islands in 1878. From early Indian reports Dawson concluded that the native deer was a wapiti (*Cervus elaphus roosevelti* Merriam), which occurs on Vancouver Island. After seeing skin and skull of a specimen, which was taken on the west coast of Graham Island in 1882(?), however, he recognized that it was a caribou's (Dawson, 1890). He drew this occurrence to the attention of Ernest Seton-Thompson in 1899, and Seton (1900) described the animal after examining the skull in the British Columbia Provincial Museum at Victoria (the skin having been lost in the meantime).

After the discovery of the Queen Charlotte Islands' caribou, it eluded the naturalists who visited the islands to look for it. Wilfred H. Osgood failed to find any evidence of the animal during his biological investigation of the Islands in 1900. He therefore concluded that there were no caribou on the Islands and that the type specimen probably had been secured on the mainland and imported to the Islands (Osgood, 1901). However, hopes of rediscovering the animal were kept alive by additional reports of its existence by the Haida Indians and the finding of a shed antler by Commander Hunt and Lieutenant Bills (1906). Charles Sheldon spent a month, from October 26 to November 23, 1906, in the vicinity of Naden Harbour, Graham Island, searching for this elusive mammal. Although he found a few tracks and dung, he failed to catch sight of the animal (Sheldon, 1912). Two Indians hunting three or four miles west of Naden Harbour on November 13, 1908, unexpectedly saw a small group of two stags, a doe, and a fawn. They shot the three adults and retrieved the skins and skulls, which were sent to the museum at Victoria to add to the type and to the antler picked up by Hunt and Bills. Finally, Francis Kermode, Curator of the Provincial Museum at Victoria, visited the area in 1910 and reported tracks of what he believed was the survivor of the 1908 herd (Sheldon, 1912, p. 166, and Patch, 1922). This review covers the observations of the living caribou. These I have listed chronologically in Table 1, along with the extant specimens.

The history of the race after 1910 is even more obscure. Clyde Patch and Harlan I. Smith, of the National Museum of Canada, collected birds

and mammals near Tow Hill and Masset, Graham Island, during the summer of 1919, but they obtained no information on the survival of the caribou after 1910 (Patch, 1922). Ian McT. Cowan visited the Islands in 1935 and reported that Henry White of Masset, one of the collectors of the 1908 specimens, had seen fresh tracks within the past two years (Cowan, 1936). However, in their recent book on the mammals of British Columbia, Cowan and Guiguet (1956) state that the race has been unreported since about 1920.

PLATE I



Mounted specimen of Queen Charlotte Islands' caribou (one of two stags killed in 1908) on exhibition at the British Columbia Provincial Museum, Victoria

—*Courtesy B.C. Prov. Museum*

Charles J. Guiguet spent two or three days during each of the summers of 1946 and 1947, searching the peatlands on foot between Naden Harbour and the Jalun River for signs of caribou, without success. Again in the period between March 15 and 22, 1957, he and Donald Robinson of the Department of Recreation and Conservation searched the area on foot and in a light aircraft without finding any signs of the animals (Guiguet, 1962¹).

The special interest in this caribou rests not only on its numerical status but also upon its phylogenetic relationships and zoogeographical history. It is evident from the few specimens on hand, that this was an unusual race of caribou. They were small, short-legged, and generally

¹pers. comm.

TABLE 1. *Observations of Queen Charlotte Islands' caribou*

Date	Locality	Observation	Observer	Shot	Specimens	Authority
1876	Queen Charlotte Islands(?)	1 stag with large antlers	(J. Flemming)	1 stag	BCPM no number	Possibly stag reported by G. Hallett to Hunt and Bills (1906)
1882(?)	west coast uplands	a small band	Alex. Mackenzie	1 stag	BCPM 1483 (type)	Seton (1900)
1898	Naden Harbour	1 doe	Shakwau	—	—	Osgood (1901, p. 27)
1901	Ditto	tracks of a herd	Stilanga	—	—	Osgood (1901, p. 27)
1901	Ditto	3 antlerless does	George Hallett	3	=	Hunt and Bills (1906)
1904	Ditto	tracks, dung	2 Indians	—	—	Sheldon (1912, p. 133)
1905	Ditto	tracks, dung, hair	C. Harrison, W. E. Collinson	—	—	Sheldon (1912, p. 133)
1906	Ditto	tracks, dung	Henry Edenshaw	—	—	Sheldon (1912, p. 133)
1906	Ditto	tracks, dung	C. Harrison, W. E. Collinson	—	—	Sheldon (1912, p. 133)
1906	Virago Sound	tracks, dung, 1 antler	Hunt and Bills	—	BCPM 1488	Hunt and Bills (1906)
1906	Naden Harbour	tracks, dung	C. Sheldon	—	—	Sheldon (1912)
1908	Ditto	band of 2 stags, 1 doe, 1 fawn	M. Yeomans, Henry White	3	BCPM 1484, 1486, 1487	Sheldon (1912, p. 165)
1910	Ditto	1 or 2 tracks	Francis Kermode	—	—	Sheldon (1912, p. 166)
1933	Ditto	tracks(?)	Henry White	—	—	Cowan (1936)

mouse-brown dorsally with darker faces and paler necks and flanks. Most males carried irregular antlers, and the females were usually antlerless. In a recent taxonomic review of the reindeer and caribou of the world (Banfield, 1962), I consider this form to be a member of the broad Holarctic reindeer-caribou superspecies *Rangifer tarandus* Linné and, more particularly, an aberrant geographical race of the woodland caribou series (*Compresicornis*). Its morphological differences suggest a long geographical isolation. The Queen Charlotte Islands are separated from the British Columbian coast by Hecate Strait, which varies between 30 and 60 miles in width between the offshore and coastal Islands. As this broad Strait never freezes in winter it has formed an effective geographical barrier to caribou migrants.

Dawson (1890) first pointed out that the occurrence of caribou on the Islands, in the absence of wapiti and deer (*Odocoileus hemionus* (Rafinesque)), indicated an early colonization in glacial times when the more southern species could not reach the Islands. He suggested that they might have crossed the glacier-filled Hecate Strait, or the dry Hecate Strait, immediately after the Cordilleran glacier had melted, but before the water from the melting continental glaciers filled the Strait. Recent studies of Heusser (1960) have indicated the possibility of a Wisconsin glacial refugium on the Queen Charlotte Islands,¹ in which case the caribou might have survived that glacial period on the Islands. In any event, it is fairly well established that the caribou have been isolated since the close of the Wisconsin phase of the Pleistocene Epoch, some 12,000 to 10,000 years ago.

I spent the period from July 18 to August 12, 1961, on the Queen Charlotte Islands searching for traces of the caribou or clues to their former distribution, habits, and fate. A representative collection of the Islands mammalian fauna was obtained incidentally. The present paper is a report on my observations and conclusions concerning the history of the caribou.

It is a pleasure to acknowledge the assistance and comradeship of J. Bristol Foster and Michael Bigg, students at the University of British Columbia, who joined me during my field studies.

The first camp was at Queen Charlotte, from July 19th to 25th, where the residents were interviewed, and from which base, low-level (200–500 feet) aerial reconnaissance of the northern and western parts of Graham Island were conducted. The airplane used was a Cessna 180, piloted by Douglas Carey of British Columbia Airways, Vancouver. The second camp was on Hippa Island, off the west coast of Graham Island, from July 25th to 30th from which a brief reconnaissance was made to the shores of Nesto Inlet. One day was spent on Hotspring Island, August 1/2, followed by a camp at Rose Harbour, Kunghit Island, from August 2nd to 6th. We then returned to Graham Island and camped on the Yakoun River, south of Masset Inlet, from August 8th to 11th. The details of the aerial survey are given in Table 2, and the routes are indicated in Figure 1.

¹Brown and Nasmith (Can. Field-Nat. 76 (4): 209–19, 1962) show that the Queen Charlotte Islands were completely covered during the height of the Wisconsin Glaciation, with the possible exception of nunataks in the Queen Charlotte Range along the west coast.

TABLE 2. *Aerial survey of Graham Island caribou range*

Flight No.	Date	Time	Area Surveyed	Distance in Miles	Animals Seen		
					Black Bear	Wapiti	Deer
1	July 22	Morning	Mount Needham, Tlell Meadows	76	1	3	2
2	23	Morning	Western Mountains, Naden Harbour	196	2	—	2
3	24	Afternoon	Eden Lake	132	1	—	1
4	25	Evening	West Coast	96	—	—	—
5	30	Afternoon	Rennell Sound	44	—	—	—
6	August 10	Evening	Naden Harbour peatland	116	—	—	125
Totals.....				660	4	3	130



FIGURE 1. Map of Graham Island, Queen Charlotte Islands, B.C., indicating the northern peatlands about Naden Harbour, the western highlands (above 1,000 feet), the small isolated alpine meadows (oblique hatching), and the numbered aerial survey routes (interrupted lines).

There are four main types of vegetation on Graham Island, as described by Rowe (1959). Most of the Island is covered by the Queen Charlotte Islands Section of the Coast Forest Region. This is a dense, temperate rain forest, characterized by western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), and western red cedar (*Thuja plicata*). Above 1,500 feet elevation on the Queen Charlotte Range, belts of the Coastal Subalpine Section of the Subalpine Forest Region are found. This forest is typified by the occurrence of mountain hemlock (*Tsuga mertensiana*) and yellow cedar (*Chamaecyparis nootkatensis*). There is an extensive area of peatlands, open bogs interlaced with bog forests on the northern lowlands. There are also a few scattered, steep alpine meadows on the western mountains above 2,500 feet elevation.

The early reports of caribou were confined to two areas. The type specimen was reported to have been killed on an upland meadow on the northern slope of the Queen Charlotte Range, inland from the west coast. All the other sightings were in the peatlands west of Naden Harbour. Most of the previous searches were concentrated on the peatlands during the autumn and winter months. I decided to search the alpine meadows of the Queen Charlotte Range in summer on the chance that the caribou might undertake annual altitudinal migrations from winter lowlands to alpine meadows during that season. Sheldon (1912) had expressed the same thought and in November of 1906 he climbed to a "bald" above Lake Jalun, but did not see any caribou. I found, however, that the alpine meadows are small and scattered. The largest ones on Graham Island are found around Mount Needham at the southwest corner of the Island. There are a few west of Masset Inlet and then only a few here and there north to Lake Jalun. There does not seem to be enough alpine meadow habitat near Naden Harbour to attract the caribou. No records are known for the southern end of Graham Island nor for Moresby Island where the alplands are more extensive.

During the early flights, well-beaten trails were observed on some of the alpine meadows. About 125 deer of all age classes were observed on these trails during the evening flight of August 10th, but no caribou were seen. During our stay on the Island the alpine meadows east of Hippa Island were kept under constant binocular surveillance but without success.

The forested areas were similarly surveyed from just above the tree-tops. Although a few deer, wapiti (introduced), and black bear (*Ursus americanus carlottae* Osgood) were observed, there were no signs of caribou. Ground reconnaissances were made about Eden Lake on the afternoon of July 24th, on the shores of Nesto Inlet on the evening of July 27th, and in the Jakoun River region, from August 8th to 11th, in the hope of finding some signs of caribou occupancy in the form of tracks, dung, antlers, or skeletons. All these efforts were fruitless, although there were abundant signs of deer everywhere. The growth of the vegetation in such a benign climate is so rapid that antlers and skeletons would soon be buried beneath the forest litter.

The aerial survey indicated that the broad, low peatlands surrounding Naden Harbour constituted a unique habitat on the Islands (see Figure 1). These peatlands are bordered on the west by the foothills of the Queen Charlotte Range, on the east by Masset Inlet (although there is a small extension east of the Inlet), and on the south by the better drained Coast Forest on a plateau over 500 feet in elevation. During the later flights, our attention was directed to this area. We repeatedly criss-crossed it at low elevation at different times of the day, without observing a caribou. One suspicious track was observed in the muddy bottom of a bog pool, but it was impossible to land close enough to investigate. Only a few deer were found in this habitat.

A review of the Haida reports shed some light on the problem of former caribou distribution. Only the Indian residents of Masset and Kung (Naden Harbour) seem to have known of the caribou's presence. The Skidegate Indians I interviewed firmly stated that there never had been any caribou on the Islands. It is easy to understand how Osgood concluded that there were no caribou on the Islands as his camp-sites were from Skidegate southward, and he did not reach the north end of Graham Island.

Considering that all the caribou observations, with the exception of the original sighting in 1882(?), were made on these peatlands, and that the only other open habitat for caribou—the alpine meadows—are too restricted, I believe that the caribou distribution on the Islands in recent times was restricted to this isolated area. Such a bog habitat is typical of eastern populations of woodland caribou.

A review of all the recorded observations (Table 1) indicates that very few caribou or signs of caribou ever were observed. The first sighting was that of a small herd. The tracks of a second small herd were seen in 1901. The last group of four animals was seen in 1908. Up until that year only five animals had been reported killed. Although the last group was decimated there seems little reason to conclude that the population was reduced by shooting. As all the investigators agree that the caribou were not hunted regularly by the Haidas, it seems likely that the population dwindled away because of biological or ecological factors. The restricted habitat seems to be a contributing factor. Perhaps the dense forests have encroached upon the meadow and peatlands in recent centuries.

Black bears are the only large predators on the Islands, and there is no reason to suspect that predation played a significant role in the caribou decline.

The physical features of the race—irregular antlers and small size—have led to the suggestion that the population might have been biologically senile, but there is little supporting evidence to assume this. Small size is a typical feature of island populations of mammals, and small antlers would probably be advantageous in the forest habitat. Sitka deer (*Odocoileus hemionus sitkensis* (Merriam)) were introduced to the Queen Charlotte Islands shortly before 1900 (Osgood, 1901). They increased slowly at first but rapidly after 1927. They are now found abundantly everywhere from

the alpine meadows to the outer islands. One might suspect that they might have been involved in the caribou decline through competition. However, the caribou decline occurred before the deer became plentiful, and, in addition, deer still appear to be uncommon on the peatlands.

All the evidence on hand points to the conclusion that the Queen Charlotte Island's caribou (*Rangifer tarandus dawsoni*) became extinct shortly after 1910. The reasons for its decline are obscure. Human interference seems to have played only a minor role. Deterioration of habitat because of amelioration of climate and loss of genetic plasticity through isolation were probably important contributory factors.

RÉSUMÉ

Le caribou des îles Reine-Charlotte (*Rangifer tarandus dawsoni* Seton) est un des mammifères les moins connus du Canada. G. M. Dawson a été le premier à en signaler l'existence lors d'une exploration géologique de ces îles en 1878. En 1900, il signalait l'existence de cet animal à l'attention du naturaliste canadien Ernest Seton-Thompson, qui fit une description scientifique de cet animal en se fondant sur l'unique spécimen qui avait été capturé en 1882.

Après sa découverte, ce caribou a échappé aux recherches des naturalistes qui ont visité ces îles. Seule la découverte de bois tombés, faite en 1906, a permis de conserver l'espoir de retrouver cet animal, jusqu'à ce qu'en 1908 deux Indiens Haïda trouvèrent par hasard un petit groupe de quatre caribous et en abattirent trois spécimens pour le Musée provincial de la Colombie-Britannique. La dernière observation signalée rapporte la présence de pistes aperçues en 1910.

Depuis lors, personne n'a réussi à trouver trace de cet animal. L'auteur du présent ouvrage a visité les îles au cours de l'été de 1961, afin de rechercher des preuves de la présence du caribou et d'acquérir une meilleure connaissance de sa situation sur les plans écologique et zoogéographique. Bien qu'on n'ait relevé aucune trace de cet animal et qu'il ait fallu considérer cette espèce comme éteinte, l'étude des connaissances acquises au sujet de cette race d'animaux a révélé quelques détails intéressants.

Le caribou des îles Reine-Charlotte était une race bien distincte de l'espèce holarctique renne-caribou, *Rangifer tarandus*; il appartenait plus particulièrement au groupe de sous-espèces du renne des bois de l'Amérique. Ses caractéristiques morphologiques font supposer un isolement assez prolongé. Pendant la dernière phase de glaciation du Wisconsin, les îles Reine-Charlotte étaient entièrement couvertes d'une calotte glaciaire insulaire. Le caribou s'est probablement rendu de la terre ferme jusqu'aux îles au cours de la période de glaciation décroissante qui a eu lieu il y a environ 12,000 à 10,000 années, traversant le détroit d'Hécate recouvert de glace ou asséché. Au cours des dernières années, ce caribou était cantonné dans une vaste étendue de terrain tourbeux qui entourait le havre Naden à l'extrémité nord de l'île Graham. Il ne se trouve à cet endroit aucune vaste étendue de prairies alpestres comme celles qui sont ailleurs caractéristiques

de l'habitat des rennes. Rien n'indique que la déprédation, la concurrence ou la chasse par les indigènes aient joué un rôle important dans l'extermination de ce caribou. Il est probable que les variations de climat, au cours des derniers siècles, qui ont causé l'empiétement de la forêt, ont réduit l'habitat dont disposait cette espèce, et cette dernière, à cause de sa fixité génétique dans l'isolement, n'a pu s'adapter aux nouvelles conditions.

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SYSTEMATIC NOTES ON THE SCULPIN GENERA *ARTEDIELLUS*, *ICELUS*, AND *TRIGLOPS* ON ARCTIC AND ATLANTIC COASTS OF CANADA

By D. E. McALLISTER

INTRODUCTION

New material has revised former views on the species of *Arctediellus*, *Icelus*, and *Triglops*, found on the Arctic and Atlantic coasts of Canada. Systematic and distributional notes are presented on the species of these genera. The distribution of *Arctediellus uncinatus* and *A. atlanticus* is clarified; new distinguishing characters are proposed for the species of *Icelus*; *Triglops murrayi* is reported from the Atlantic coast and distinguished from the more northern *T. pingelii*. Diagnostic characters and meristic counts are given for each species. Keys to the species of each genus are presented.

Lest it be assumed that knowledge of the species discussed herein is fairly complete, one should keep in mind that our knowledge of geographical and vertical distribution and life-history is very incomplete. Further specimens are required.

Dorsal and anal ray counts include the ultimate and penultimate rays separately.

ACKNOWLEDGMENTS

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SYSTEMATICS AND DISTRIBUTION

Arctediellus

In 1898 Jordan and Evermann described a new eastern American species of *Arctediellus*, *A. atlanticus*, differentiating it from *A. uncinatus* of Greenland and Europe. As the diagnostic characters which they gave did not prove valid, some later authors, such as Bigelow and Schroeder (1953), synonymized the two species. In 1952 Jensen found the two species inhabiting Greenland and discovered new diagnostic characters. Backus (1957)

then recorded *A. uncinatus* from Labrador. It was then clear that there were probably two species of *Artediellus* in Canada, but the distribution of the two species was unknown (McAllister, 1960). Collection and examination of Canadian specimens of *Artediellus* have partially clarified the distribution pattern. *Artediellus uncinatus* is found in Labrador and is apparently absent northwards from the fairly well-explored Hudson Strait region. This species is further known in Greenland. *Artediellus atlanticus* is found in the Gulf of St. Lawrence, on the Grand Banks, and southward along the coast of the United States. It is also known in Greenland, near Iceland and northern Europe (where it was known under the name of *A. europaeus*). *A. uncinatus* and *atlanticus* probably meet or overlap on the Atlantic coast in the Strait of Belle Isle region.

A third species, *A. scaber*, has now been found in western Arctic Canada (McAllister, 1962). The exact eastward limits of distribution of this species remain to be delineated. However, *scaber* probably occurs eastward to at least Dolphin and Union Strait (McAllister, 1962). Table 1 below compares the meristic characters in Canadian specimens of *Artediellus*.

Table 1. Comparison of Meristic Characters in Canadian *Artediellus*

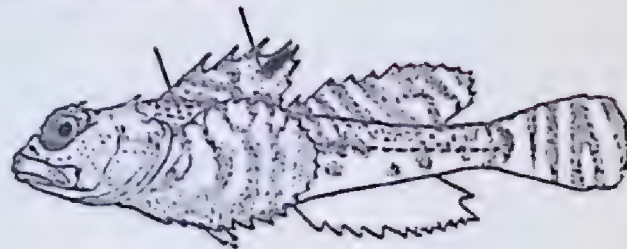
	Number of Dorsal Spines			Number of Dorsal Rays				Number of Anal Rays				Number of Pectoral Rays			
	VII	VIII	IX	12	13	14	15	10	11	12	13	19	20	21	22
<i>scaber</i>	—	9	1	1	7	2	—	—	5	4	1	3	5	2	—
<i>uncinatus</i> (after Backus)	1	7	—	8	5	—	—	5	7	1	—	—	—	5	8
<i>atlanticus</i>	—	11	—	—	1	9	1	—	1	7	3	—	—	7	3

	Number of Lateral Line Pores											Number of Dorsal Rays + Anal Rays						
	18	19	20	21	22	23	24	25	26	27	28	22	23	24	25	26	27	28
<i>scaber</i>	—	—	—	—	—	1	1	3	3	1	1	—	1	4	3	1	1	—
<i>uncinatus</i>	—	—	—	—	—	—	1	1	5	2	2	3	4	3	1	—	—	—
<i>atlanticus</i>	1	—	5	1	1	—	—	3	—	—	—	—	—	—	2	6	2	1

The following key will serve to identify the Canadian species. A list of the specimens studied will be found under *Material examined*. Where NMC precedes catalogue number it denotes National Museum of Canada material, and USNM denotes United States National Museum material.

Key to Canadian Species of *Artediellus*

- 1 (2) Cirri and conical tubercles on nape and anterior dorsum. Nasal spines absent (do not prick finger). Pectoral rays 19-21. *Artediellus scaber* Knipowitsch—western Canadian Arctic.

♂ *Artediellus scaber*.

- 2 (1) Cirri and conical tubercles lacking on nape and anterior dorsum. Nasal spines present. Pectoral rays 21-22.

♂ *Artediellus uncinatus*.

- 3 (4) Dorsal plus anal rays 22-25. Dorsal rays 12-13, anal rays 10-12, lateral line pores 24-28. Dorsals of mature male black with round white spots. *Artediellus uncinatus* (Reinhardt)—Labrador.

- 4 (3) Dorsal plus anal rays 25-28. Dorsal rays 13-15, anal rays 11-13, lateral line pores 18-25. Dorsals of mature male with black and light bands. *Artediellus atlanticus* Jordan and Evermann—Newfoundland and southward.

♂ *Artediellus atlanticus*.*Material Examined*

Artediellus USNM165420: Lake Melville just ne. of Goose Bay, Labrador, *uncinatus* two specimens; USNM165427: 3 miles ne. of Sandy Point, near entrance of Goose Bay, Labrador, one specimen, USNM165385: w. end of Naire Bay, Labrador, five specimens; USNM165295: n. side of Hamilton Inlet, Labrador, one specimen; USNM165189: Lake Melville, Labrador, two specimens.

Artediellus atlanticus: The following three collections belong to Gerard Drainville No. 61-108, Baie des Iles, Saguenay, Quebec, 15 specimens, 91.4 mm; No. 61-109, *ibid.*, one specimen, 99 mm; No. 61-74, Cap Jaseux, Saguenay, Quebec, two specimens, 71-90 mm; NMC61-211, 24 mi. se. of Cap d'Espoir, Gaspé Pen., Quebec, Gulf of St. Lawrence, three specimens, 51-58 mm; NMC61-213, 38 mi. s. of South Point, Anticosti Island, Quebec, Gulf of St. Lawrence, four specimens, 48-58 mm.

Artediellus scaber: NMC60-472, se. stern Herschel Island, Yukon, four specimens, 50-58 mm; NMC60-466, 1½ mi. s. of Simpson Pt., Herschel I., Y.T., four specimens, 52-62 mm; NMC60-478, 17 mi. w. of Herschel Island, 41-43 mm.

A fine paper by Andriashev was received too late to include in this study, but it does not conflict with opinions written here (Andriashev, A.P. 1961. Voprosi Ikhtiologi 1(2): 231-42, 6 fig. [Observations on the sculpin genus *Artediellus* Jord. in Bering Sea] (In Russian)).

Icelus

Previously *Icelus spatula* and *I. bicornis* were not distinguished; in 1937 Andriashev distinguished *bicornis* from *spatula* on the basis of the genital papilla. In 1949 Jensen and Helge discovered a further differentiating character, the presence of minute spines on the lower portion of the lateral line plates in *bicornis*. Andriashev (1954) added a further character—the number of lateral line plates—to their diagnosis. Walters (1953, 1955), Dunbar and Hildebrand (1952), and Backus (1957) have added to the knowledge of their distribution.

This paper adds to the differentiating characters, presents new distributional records, corrects records, and summarizes the distribution.

Additional characters were found to separate the two species. These are illustrated in the figures for the key. A spine was found at the base of the caudal fin and below the midline in *bicornis* but not in *spatula*. A spine is usually found just above the anal fin origin in *bicornis* but not in *spatula*. A patch of ctenoid scales was found in the axillary region of the two species. In the uppermost row of these, next to the lateral line, are 0-6, usually 1-3 in *spatula*; 3-9, usually 5-7 in *bicornis*. These three characters are particularly useful since they can be applied in both sexes, unlike the conformation of the male genital papilla, and since they are useful even in small specimens, unlike the shape and number of lateral line plates. However, there is some overlap in the number of the upper row of axillary scales and a few, about 10 per cent, *bicornis* lack the spine at the base of the caudal fin. The presence of a spine above the anal origin is not highly diagnostic. Only in about half the *bicornis* was it present; it was never present in *spatula*. This anal scale may be followed by others above the anal fin base. The number of lateral line scales is often not complete at standard lengths of 45 mm or less. The numbers of fin rays in the two species overlap, although the modal number of anal and pectoral rays in the two species is different. Table 2 below presents the meristic and other morphological characters in the two species. Below the table a key to the species is presented.

Table 2. Comparison of Canadian Species of *Icelus*

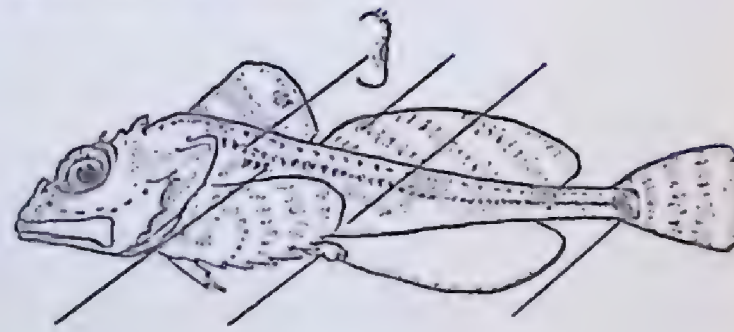
	Spine at Caudal Base below Midline		Scale above Anal Origin		Number of Scales in Upper Axillary Row									
	+	-	+	-	0	1	2	3	4	5	6	7	8	9
<i>spatula</i>	0	57	0	57	3	14	26	11	3	2	1	-	-	-
<i>bicornis</i>	35	4	17	22	-	-	-	3	6	23	26	8	4	1

Table 2. Comparison of Canadian Species of *Icelus*—Concluded

	Number of Dorsal Spines			Number of Dorsal Rays				Number of Anal Rays				Number of Pectoral Rays					
	VIII	IX	X	19	20	21	22	14	15	16	17	16	17	18	19	20	
<i>spatula</i>	3	29	7	11	21	9	—	1	21	15	4	—	6	22	12	2	
<i>bicornis</i>	2	23	6	8	11	8	2	7	14	8	1	3	16	10	—	—	
	Number of Lateral Line Plates (in specimens above 45 mm)																
	33	34	35	36	37	38	39	40	41	42	43	44					
<i>spatula</i>	—	—	—	—	—	—	—	1	5	10	8	3					
<i>bicornis</i>	3	2	6	4	2	2	1	—	2	—	—	—					
								Spines Below Pore on Lateral Line Plate (in specimens above 45 mm)									
								+			—						
<i>spatula</i>									—			36					
<i>bicornis</i>									36			8					

Key to the Canadian Species of *Icelus*

1 (2) No spine at base of caudal fin below midline. In specimens above 45 mm standard length, no spines below pores on lateral line scales; lateral line scales number 40–44. Lateral line usually complete. Usually 1–3 (rarely 0–6) scales in upper axillary row below lateral line. Never spine above anal origin. Base of genital papilla of male long, tip short, curved, claw-like *Icelus spatula* Gilbert and Burke.

♂ *Icelus spatula*.

2 (1) Usually spine at base of caudal fin below midline. In specimens above 45 mm standard length usually with spines below pore on lateral line scale; lateral line scales usually number 33–39 (rarely to 41). Lateral line usually incomplete. Usually 4–7 (rarely 3–9) scales in upper axillary row below lateral line. Often a spine above anal origin. Base of genital papilla of male short and with a long conical, straight tip. *Icelus bicornis* (Reinhardt).

♂ *Icelus bicornis*.

Dannevig (1919) recorded *Icelus bicornis* from near Prince Edward Island and the Magdalens in Gulf of St. Lawrence, and Jean (1954) recorded a specimen from Baie des Chaleurs also in the Gulf of St. Lawrence.

Jean's specimen was not available for examination. However, several other collections from the Baie des Chaleurs region (see *Material Examined*) were studied; all proved to be *spatula*. Although *bicornis* is known from Ungava Bay, northern Quebec, it was not found further south in Labrador amongst Backus's many specimens of *spatula*. It therefore appears that *spatula* is a more southerly species and that previous Gulf of St. Lawrence records of *bicornis* were actually *spatula*. There is, however, a broad zone of overlap of the two species in the low Arctic. The largest *spatula* examined was 85 mm in standard length; the largest *bicornis* 65 mm.

Material Examined

Icelus spatula: NMC59-432, Ungava Bay; NMC60-105, Cape Jensen, Baffin Island, Foxe Basin, N.W.T.; NMC60-92, eastern Fury and Hecla straits, N.W.T.; NMC60-70, Evans Strait, N.W.T.; NMC59-461, Potter Island, S.E. Frobisher Bay, N.W.T.; NMC59-463, N.E. Frobisher Bay; NMC59-373, Ungava Bay, P.Q.; NMC60-94, Hooper Inlet, west Foxe Basin, N.W.T.; NMC60-87, Skeoch Bay, N. Foxe Basin, N.W.T.; NMC60-100, Hooper Inlet, west Foxe Basin, N.W.T.; NMC60-93, Hooper Inlet, W. Foxe Basin, N.W.T.; NMC60-466, Herschel Island, Y.T.; NMC60-472, Herschel Island, N.W.T.; NMC60-473, Herschel Island, N.W.T.; NMC60-476, Herschel Island, N.W.T.; NMC60-477, Slidre Fjord, Ellesmere Island, N.W.T.; NMC61-210, 17 mi. se. of Percé, Gaspé, P.Q.; the following are from the collections of Station Biologique du Grande Rivière: Baie des Chaleurs off Nouvelle Pt. at 47° 59' 00" N., 65° 03' 49" W. at 84-79 m; Baie des Chaleurs off Miscou Island, N.B., at 48° 05' N., 64° 39' W., at 55 and 69 m; Baie des Chaleurs at 47° 54½' N., 65° 35' 00" W. at 51 m; Baie des Chaleurs at 47° 59' N., 64° 46' W. at 48 m.

Icelus bicornis: NMC59-377-A, west Foxe Basin, N.W.T.; NMC59-11, Mould Bay, Prince Patrick Island, N.W.T.; NMC 60-106, Foxe Basin, N.W.T.; NMC59-450, Hudson Strait, S. Baffin Island; NMC58-266, Parr Inlet, Alert, Ellesmere Island, N.W.T.; NMC59-13-B, Slidre Fjord, Ellesmere Island, N.W.T.; NMC59-469, Frobisher Bay, N.W.T.; NMC60-53, Mansel Island, N.W.T.; NMC59-8, Mould Bay, Prince Patrick Island; NMC60-103, north Foxe Basin; NMC60-105, Cape Jensen, Baffin Island, N.W.T.; NMC58-23, Kane Basin, Ellesmere Island, N.W.T.; NMC60-476, Herschel Island, Y.T.; NMC60-455-A, Isachsen, Ellef Ringnes Island, N.W.T.; NMC60-445 and 444-A at same locale; NMC58-266, Alert, Ellesmere Island, N.W.T.; NMC59-450, 33 mi. s. of Lake Harbor, Baffin Island, N.W.T.

Triglops

Two species of *Triglops* are reported from Atlantic and Arctic Canadian waters in current North American papers, *Triglops pingelii* from both Arctic and Atlantic waters and *Triglops nybelini* from eastern Arctic waters (Dunbar and Hildebrand, 1952; Bigelow and Schroeder, 1953; Walters, 1955; Backus, 1957; McAllister, 1960). Another species, *T. ommatistius* Gilbert 1913, has been recognized from Atlantic waters, and Jordan, Evermann and Clarke (1930) had raised one of its subspecies, *terrae-novae* Gilbert 1913,

to specific status. However, Jensen (1944) followed by Backus (1957) considered *ommatistius* a synonym of *pingelii*. None of the aforementioned papers mentioned the study of Andriashev (1949). In this study Andriashev recognized three species in northern seas, *pingelii*, *nybelini*, and *murrayi*. Andriashev synonymizes *ommatistius* and *terrae-novae* with *murrayi* Günther 1888. Comparison of Günther's and Gilbert's descriptions shows this to be correct. Andriashev reports *T. murrayi* on the Atlantic coast of Europe, Iceland, Greenland, and eastern North America. Examination of a series of eastern Canadian specimens confirmed Andriashev's findings, that there are two species of small-eyed *Triglops* on the east coast, *murrayi* and *pingelii*. *Triglops murrayi* occurs off the United States and northwards to the coast of Labrador and Ungava Bay, with one record for Term Point, northwestern Hudson Bay at 62° 08' N., 92° 28' W.

Triglops pingelii is found on the Yukon coast and eastward to Hudson Bay and Strait and south to St. Lewis Inlet, Labrador, at 52° 20' N., 55° 51' W. The two species are thus sympatric over a fairly wide area and in one case were brought up in the same dredge haul in Ungava Bay, Collection NMC59-432. A third species, *T. nybelini*, is known in Canada only from Ungava Bay and Hebron Fjord, Labrador (Backus, 1957). Thus the three species are sympatric in Ungava Bay and Labrador.

The table below summarizes the diagnostic characteristics of the species. Though Andriashev found he was able to separate *murrayi* from *nybelini* on the basis of its inner rather than middle pelvic ray being longest, this character did not always hold up in Canadian specimens. Neither was the caudal peduncle depth of key value, being 3.0 to 4.6 per cent of standard length in *murrayi* and 2.9 to 4.4 per cent in *pingelii*. The angle of the ascending processes of the premaxillary to the lower surface of the head, 52 to 67 degrees in *murrayi* and 48 to 57 degrees in *pingelii*, showed some difference but not of practical value. The black spot noted by Andriashev in the posterior spinous dorsal of the male of *murrayi* serves to distinguish it from other species. Another small black spot, unnoted by other authors, which was found between the tips of the first two dorsal spines of both sexes in *murrayi* but not in other species, proved a good diagnostic feature. The largest *nybelini* examined was 106 mm in standard length, *murrayi* 105 mm, and *pingelii* 110 mm.

Table 3. Comparison of Characters in Species of Canadian *Triglops*

	Pelvic Ray Longest		Spots in Spinous Dorsal				Caudal Bars		Orbit- Postorbit	
			Anterior		Posterior					
	Middle	Inner	+	—	+	—	+	—	Equal or Plus	Less
<i>nybelini</i>	2	—	—	2	—	2	—	2	2	—
<i>murrayi</i>	2	6	9	1	7	11	15	—	3	12
<i>pingelii</i>	1	18	—	19	—	19	—	19	1	25

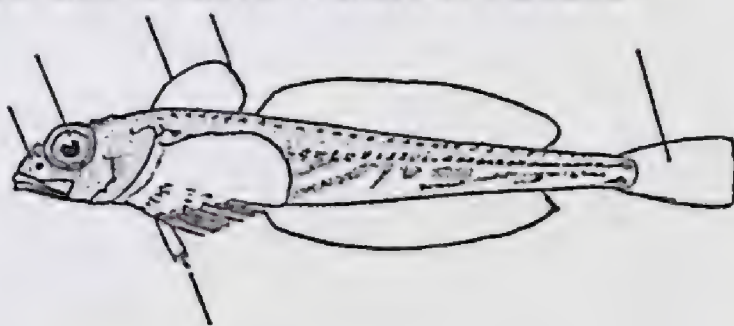
Table 3. Comparison of Characters in Species of Canadian *Triglops*—Concluded

	Dorsal Spines			Dorsal Rays						Anal Rays						
	X	XI	XIII	21	22	23	24	25	26	21	22	23	24	25	26	27
<i>nybelini</i>	2	—	—	—	—	—	2	—	—	—	—	1	—	—	—	1
<i>murrayi</i>	11	3	—	—	3	8	3	1	—	1	7	7	1	—	—	—
<i>pingelii</i>	1	19	8	—	—	1	6	15	6	—	—	6	12	11	3	—

	Pectoral Rays					Total of Dorsal Spines + Rays					
	18	19	20	21	22	32	33	34	35	36	37
<i>nybelini</i>	—	—	—	2	1	—	—	2	—	—	—
<i>murrayi</i>	14	4	—	—	—	2	8	3	1	1	—
<i>pingelii</i>	20	10	—	—	—	—	—	1	2	12	10

Key to the Species of *Triglops* in Arctic and Atlantic Waters of Canada

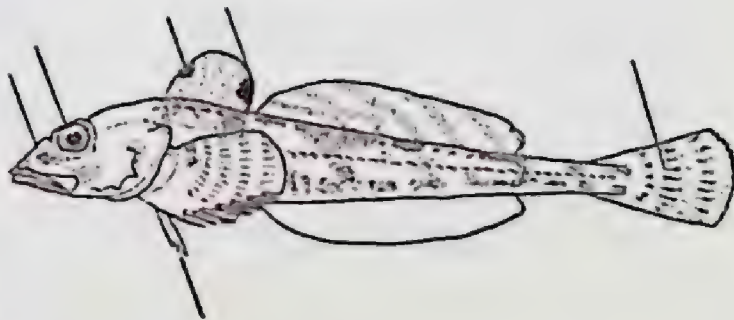
- 1 (2) Pectoral rays 20–22. Melanophores dense on peritoneum. Middle pelvic ray longest. Orbit large, equals or exceeds postorbital length of head. *Triglops nybelini* Jensen.



♂

Triglops nybelini.

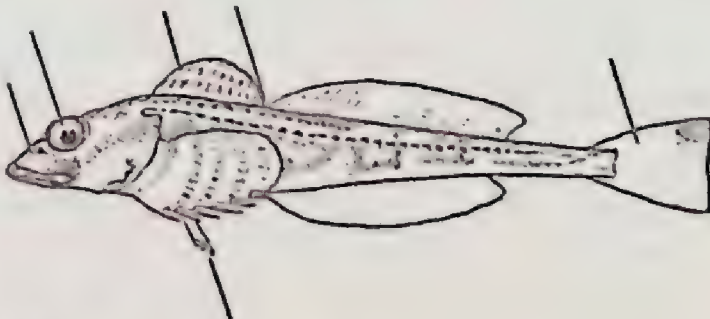
- 2 (1) Pectoral rays 18–19. Melanophores on peritoneum sparse. Middle or inner pelvic ray the longest. Orbit smaller, less than postorbital length of head.



♂

Triglops murrayi.

- 3 (4) Dark bars across caudal fin. Dark spot at tip of first dorsal spines. In males dark spot in posterior spinous dorsal. Anal rays modally 22–23 (21–24). Total of dorsal spines and rays usually 32–34 (32–36). *Triglops murrayi* Günther.



♂

Triglops pingelii.

- 4 (3) Caudal without bars. No dark spots in dorsal of either sex. Anal rays modally 23–25 (23–26). Total of dorsal spines and rays usually 35–37 (34–37). *Triglops pingelii* Reinhardt.

Material Examined

Triglops nybelini: NMC59-368: Port Burwell, Quebec, one specimen; NMC59-369: Port Burwell, Quebec, one specimen; NMC59-437: north central Ungava Bay, Quebec at 60° 14' N., 68° 26' W., one specimen.

Triglops murrayi: NMC60-62: off Term Point, nw. Hudson Bay, one specimen; NMC59-444: Inusulik Island, Ungava Bay, Quebec, five specimens; NMC61-210: 17 mi. se. of Percé, Gaspé Pen., Quebec, one specimen; NMC61-211: 24 mi. se. of Cap d'Espoir, Gaspé Pen., Quebec, six specimens; NMC62-214: 52 mi. s. of South Point, Anticosti Island, Quebec, one specimen; NMC59-432: just n. of Payne Bay, Ungava Bay, Quebec, one specimen; USNM165277: Island of Ponds, Domino Harbor, Labrador, one specimen; USNM177567: Nain Anchorage, Labrador, one specimen; USNM165280: Kangalakoioruik, Labrador, one specimen; USNM165283: St. Lewis Sound, Labrador, one specimen.

Triglops pingelii: NMC59-470: Frobisher Bay, 13 miles sw. of Countess of Warwick Sound, N.W.T., seven specimens; NMC60-61: Chesterfield Anchorage, Hudson Bay, N.W.T., one specimen; NMC59-369: Port Burwell, Quebec, one specimen; NMC59-463: mouth of Frobisher Bay, N.W.T., two specimens; NMC59-377-A: western Foxe Basin, N.W.T., one specimen; NMC59-446: Diana Bay, Quebec, one specimen; NMC59-432: just n. of Payne Bay, Ungava Bay, Quebec, two specimens; NMC59-410: Forbes Sound, Ungava Bay, Quebec, one specimen; NMC60-102: northern Foxe Basin, N.W.T., one specimen; NMC59-462 and NMC59-469: Countess of Warwick Sound, Frobisher Bay, N.W.T., two specimens; NMC60-92: nw. Foxe Basin, N.W.T., one specimen; NMC59-366: Port Burwell, Quebec, one specimen; NMC60-476, 60-475, 60-478, 60-472, 60-473: about Herschel Island, Y.T., ten specimens; USNM65285: Hebron Fjord, Labrador, one specimen; USNM165284: St. Lewis Inlet, Labrador, one specimen; USNM165282: Lake Melville off Lowland Point, Labrador, one specimen; USNM165281: Kangalakoioruik, Labrador, one specimen.

RÉSUMÉ

De nouveaux spécimens ont amené l'auteur à modifier sa manière de voir au sujet des espèces *Arctodiellus*, *Icelus* et *Triglops* qui habitent les eaux des côtes arctiques et atlantiques du Canada. Les diverses espèces de ces genres font ici l'objet d'observations sur leur classement systématique et leur aire de distribution. L'auteur apporte des précisions au sujet de l'aire de distribution de l'*Arctodiellus uncinatus* et de l'*A. atlanticus*; il propose de nouveaux traits distinctifs pour les espèces d'*Icelus*; il signale la présence du *Triglops murrayi* dans les eaux côtières de l'Atlantique et il donne les traits qui le distinguent de l'espèce plus septentrionale, le *T. pingelii*. Pour chaque espèce sont donnés les traits distinctifs et les résultats de dénombrements méristiques. Le présent travail comprend aussi des clefs des diverses espèces de chaque genre.

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A SELECTION OF NEOTYPES FOR SUBSPECIES OF *RANGIFER* *TARANDUS* (LINNÉ) (MAMMALIA-CERVIDAE)

By A. W. F. BANFIELD

A recent revision of the genus *Rangifer* (Banfield, 1962) disclosed that an understanding of the classification of the reindeer-caribou group was handicapped by the absence of type specimens representing early scientific names. Early reindeer taxa, described by Linné (1758 and 1767), Gmelin (1788), Richardson (1829), and Vrolik (1829), were based upon personal accounts of the animals in the field, or upon explorers' accounts, but without the designation of type specimens. Such taxonomic practice was commonplace in the eighteenth and early nineteenth centuries. Later taxa, described by various authors, are supported by extant holotypes. The designation of neotypes for the older taxa is in the interests of nomenclatorial stability of the group and will help clarify the present confusion in identifying certain closely related taxa.

Allen (1908), Lonnberg (1909), and Miller (1912), among others, have aided the cause by fixing type localities for some early taxa. Efforts in 1959, to locate syntype material in museums of northern Europe, met with no success. There remains the final step of designating neotypes as authorized under Article 75 of the International Code of Zoological Nomenclature, adopted by the XVth International Congress of Zoology (1961).

The recognition of acceptable subspecies is based upon concordant statistically-valid differences in meristic characters of geographical populations. The present designation of neotypes does not signify a typological approach to taxonomy. The neotypes are intended only to serve as "standard bearers" to aid in a visual appreciation of differences in the recognized taxa.

ACKNOWLEDGMENTS

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Rangifer tarandus tarandus (Linné) 1758

Cervus tarandus Linné, 1758. Syst. Nat., 10 ed., 1: 67

Type locality. Mountains of northwest Sweden (Särna and Idre Parishes, Dalarna Province). Type locality fixed by Lonnberg (1909).

Neotype. No. 4661, collection of mammals, Naturhistoriska Riksmuseet, Stockholm, Sweden (Plate I).

Data. Skull of young adult male wild reindeer collected by Wegelin, April 26, 1836, at Langfjället, Särna Parish, Dalarna (Dalecarlia), Sweden.

Description. Skull measurements after Banfield (1962): basal length 336, orbital width 162, nasal length 117, nasal width 64.5, tooth row 99.4, skull width at canines 63.4, incisive foramen length 49.4, diastema length 117, post nares width 41.9, occipital height 148 mm.

Diagnosis. A medium-sized tundra reindeer; autumn pelage: olive-brown above, cheeks paler, legs darker, prominent white muzzle, neck, flank stripe, and belly; antlers pale brown, long digitate, cylindrical beams (most females carry antlers); skull moderately large, orbits protruding and angled forward, nasals short, broad and flat, tooth row short (Banfield, 1962, p. 43-50).

Distribution. Tundra and taiga zones of northern Europe and Asia.

Remarks. Lonnberg (1909) carefully compared his *R. t. fennicus* with the Linnaean nominate race. He first fixed the type locality of *tarandus* in the mountains of northwest Sweden, based upon Linné's travels. Lonnberg cited a series of three skulls in Stockholm from that area: the present selected neotype, No. 4662 (a younger male), and No. 4663 (an adult female). I examined the specimens in the Naturhistoriska Riksmuseet on July 7, 1959. The selected neotype is consistent with what is known of the probable type material used by Linné, as outlined above.

***Rangifer tarandus groenlandicus* (Linné) 1767**

Cervus tarandus (Syn. *Capra groenlandica*) Linné, 1767. Syst. Nat., 12 ed., 1: 98

Type locality. Southwest coast of Greenland.

Neotype. No. 8831, collection of mammals. National Museum of Canada, Ottawa, Canada (Plate II).

Data. Skull of adult male wild reindeer collected by Dr. Morten P. Porsild during the winter of 1926-27 on the Nugsuak Peninsula (lat. 70° N.), west coast of Greenland.

Description. Skull measurements after Banfield (1962): basal length 354, orbital width 175, nasal length 112, nasal width 66, tooth row 93.9, width of skull at canines 72.4, incisive foramen length 49.9, diastema length 130, post nares width 45.5, occipital height 160 mm. Large digitate antlers, greatest length 1,260, greatest spread 1,090; diameter of beam above bezel 40 to 42 mm; antlers curved without "European bend."

Diagnosis. A medium-sized tundra reindeer, a little larger than the nominate race, legs noticeably longer (average length of male metatarsus 281 (274-290) compared to 274 (270-278) for *tarandus* and similarly for females, 258 (240-268) compared to 243 (240-245)); colour pattern similar but a little darker than *tarandus* in autumn; skull measurements average slightly larger as well (Banfield, 1962, p. 50-6).

Distribution. Tundra and taiga regions of continental Northwest Territories of Canada, Southampton Island, Baffin Island, and southwest coast of Greenland.

Remarks. The race inhabiting southwest Greenland has been recognized since the early eighteenth century. Linné listed Edwards' (1743), *C. groen-*

landica in the synonymy of the nominate race in the 12th edition of *Systema Naturae*. Borowski (1780) used a slightly different spelling, *gronlandicus*, but Gmelin (1788) returned to the original spelling in the 13th edition. These early descriptions were based upon explorers' accounts of voyages to the southwest coast of Greenland. The selected neotype is therefore consistent with the probable type material utilized by Linné.

***Rangifer tarandus arcticus* Richardson 1829**

Rangifer tarandus var. *α*, *arctica* Richardson, 1829. Fauna Boreali-Americana, 1: 241.

Type Locality. Fort Enterprise, Winter Lake, Mackenzie Dist., N.W.T., Canada (Allen, 1908).

Neotype. No. 22066, collection of mammals. National Museum of Canada, Ottawa, Canada (Plate III).

Data. Skull of adult female barren ground caribou collected by J. P. Kelsall, September 6, 1952, at Aurora Lake (about 5 miles south of the site of Fort Enterprise), Mackenzie District, N.W.T., Canada.

Description. Skull measurements after Banfield (1962): basal length 303, orbital width 154, nasal length 91.9, nasal width 53.7, tooth row 82.2, diastema length 114, incisive foramen length 53.2, mastoid width 100, width of skull at canines 46.1, occipital height 120.5. Antlers sawn off.

Body measurements: total length 1,550, shoulder height 960, hind foot 480 mm, weight 83.5 kg.

Diagnosis. I consider this population to represent a deme indistinguishable from *R. t. groenlandicus* (Banfield, 1962, p. 53-4).

Remarks. The type locality of Richardson's *arcticus* was fixed by J. A. Allen (1908). The comparison of this population with other named forms has been hampered for many years by the lack of material from the type locality. The National Museum of Canada has recently obtained several specimens from the general vicinity of Winter Lake, including bulls from Ross, Watta, and Grant lakes (approximately 100 miles away) as well as several young animals from the immediate vicinity of Winter Lake. *R. t. arcticus* is still the name in general use for North American tundra reindeer. The relationship between this deme and other named varieties will be more easily understood with the designation of the neotype. Efforts to find Richardson's syntype material in the British Museum (Natural History) in 1959 were unsuccessful (Banfield, 1961).

***Rangifer tarandus platyrhynchus* (Vrolik) 1829**

Cervus (Tarandus) platyrhynchus (Vrolik) 1829. Nieuwe Verhandl. Kon. Nederl. Instit., 1 Klasse, pt. 2, p. 160

Type locality. Spitsbergen Archipelago (Miller, 1912).

Neotype. No. M2625 collection of mammals Zoologisk Museum, Universitet i Oslo, Oslo, Norway (Plate IV).

Data. Skull, skin, and skeleton of adult male collected in Sassendalen, Spitsbergen Archipelago, by A. J. Pflégard, some time between February 1 and May 15, 1935.

Description. Skull measurements after Banfield (1962): basal length 305, orbital width 158, nasal length 96.4, nasal width 49.0 (nasals distally expanded), tooth row 92.0, width of skull at canines 58.0, incisive foramen length 43.0, diastema length 103, post nares width 34.5, occipital height 129 mm.

The skin is complete, but it is badly slipped on both flanks. The pelage is typical of spring conditions—the hair is very long and faded and the tips are much abraded, so that the dorsal colour is strongly influenced by the basal colour of the hairs. The following capitalized colour names are from Ridgway's (1912) colour standards: muzzle, silvery white; lower lip with Drab stripe; nose and eyebrow, Warm Sepia; cheeks, Pale Ochraceous Salmon; forehead, white; a spot behind the ears, Pallid Mouse Gray; neck and throat, white; shoulders and flank stripe, Light Buff; back, Avellaneous; tail, white with restricted dorsal Pale Drab stripe; lower flank stripe, Light Drab; restricted chest spot, Drab; belly, creamy white; anterior stripe on legs, Light Drab; white posteriorly, narrow creamy white "sock" band above the hooves; large rump patch, creamy white.

Diagnosis. Small pale-coloured tundra reindeer with short legs; nasal bones distally expanded; supraoccipital foramina usually lie in a groove, occipital condyles separated by a narrow ventral groove; antlers whitish, slender, and digitate (Banfield, 1962, p. 66–9).

Distribution. Spitsbergen, Archipelago.

Remarks. Miller (1912) restricted the type locality of *platyrhynchus* to Spitsbergen, based upon the original author's itinerary. Although there have been several monographs on the race (Camerano, 1902, and Wollebaek, 1926), no type specimen has been designated heretofore.

Rangifer tarandus caribou (Gmelin) 1788

Cervus tarandus γ *caribou* Gmelin, 1788. Linn. Syst. Nat., 13 ed., 1: 177

Type locality. Quebec, Province of Quebec, Canada (Banfield, 1962).

Neotype. No. 4800, collection of mammals, National Museum of Canada, Ottawa, Canada (Plate V).

Data. Skin and skull of young adult male collected by Dr. R. M. Anderson, September 17, 1922, on Mont Albert, Shickshock Mountains, Gaspé West County, Quebec, Canada.

Description. Skull measurements after Banfield (1962): basal length 369, orbital width 170, nasal length 148, nasal width 70.5 (nasals arched), tooth row 97.1, incisive foramen length 62.5, skull width at canines 82.5, diastema length 140, occipital height 146 mm. Antlers dark brown, greatest length 800, greatest spread 530 mm.

External measurements: total length 2,130, tail 148, hind foot 601 mm.

Colour of fresh autumn pelage (capitalized names from Ridgway, 1912): face, Fuscous; neck, Tilleul Buff; back, Clove Brown; flank stripe, Tilleul Buff; chest, Fuscous; belly, Tilleul Buff; legs, Fuscous; "socks," narrow, white.

Diagnosis. A large, long-legged, forest caribou; autumn coat very dark, white flank stripe and belly patch restricted, legs blackish; hooves longer than broad; antlers dark mahogany brown, usually palmated and with flattened beams (30 to 40 per cent of females antlerless); skull long and rugose, nasals arched and elongated, cranium flattened, orbits less protruding, tooth row long with projecting post dental ridge (Banfield, 1962, p. 70-88).

Distribution. Forested regions of boreal North America including Cordilleran region.

Remarks. Unfortunately woodland caribou are now extinct in the vicinity of the type locality. A few old trophy heads are available from Laurentides Provincial Park, about 60 miles north of Quebec, but no adequate scientific specimens. Unfortunately the caribou have disappeared from that area in recent years. The only area south of the Gulf of St. Lawrence where caribou still occur in some numbers is the Shickshock Mountains of the Gaspé Peninsula. Recent revisionary studies indicated that all the woodland caribou of the Maritime Provinces, New England States, and southern Quebec belonged to the same deme as far as measurements were concerned (Banfield, 1962); therefore the neotype may be assumed to be consistent with caribou population described by Gmelin.

The designation of the neotype will facilitate an understanding of the relationships between the many named demes of American woodland caribou.

Rangifer tarandus fennicus Lonnberg 1909

Rangifer tarandus fennicus Lonnberg, 1909. Arkiv. för Zool., Bd. 6, nr. 4: 10

Holotype. No. 809/1960 of the mammal collection, Zoology Museum, University of Helsinki, Helsinki, Finland (Plate VI).

Type locality. Enontekiö Parish, Torne District, Finnish Lapland, Finland.

Remarks. Through the co-operation of the Zoology Museum, University of Helsinki, it is possible to publish photographs of the holotype of *fennicus* for the first time.

RÉSUMÉ

Les anciens taxa de rennes décrits par Linné (1758 et 1767), Gmelin (1788), Richardson (1829) et Vrolik (1829) n'étaient pas appuyés de la désignation de spécimens types. En raison de cette lacune, il est difficile de comparer ces noms avec ceux qui ont été adoptés par la suite avec l'appui de types désignés. L'auteur donne ici un nom à cinq néotypes en

conformité de l'article 75 du Code international de la nomenclature zoologique, adopté par le XV^e Congrès international de zoologie (1961).

Rangifer tarandus tarandus (Linné) 1758. Néotype: n° 4661, collection de mammifères, Naturhistoriska Riksmuseet, Stockholm, Suède.

Rangifer tarandus groenlandicus (Linné) 1767. Néotype: n° 8831, collection de mammifères, Musée national du Canada, Ottawa, Canada.

Rangifer tarandus arcticus Richardson, 1829. Néotype: n° 22066, collection de mammifères, Musée national du Canada, Ottawa, Canada.

Rangifer tarandus platyrhynchus (Vrolik) 1829. Néotype: n° M2625, collection de mammifères, Zoologisk Museum, Universitetet i Oslo, Oslo, Norvège.

Rangifer tarandus caribou (Gmelin) 1788. Néotype: n° 4800, collection de mammifères, Musée national du Canada, Ottawa, Canada.

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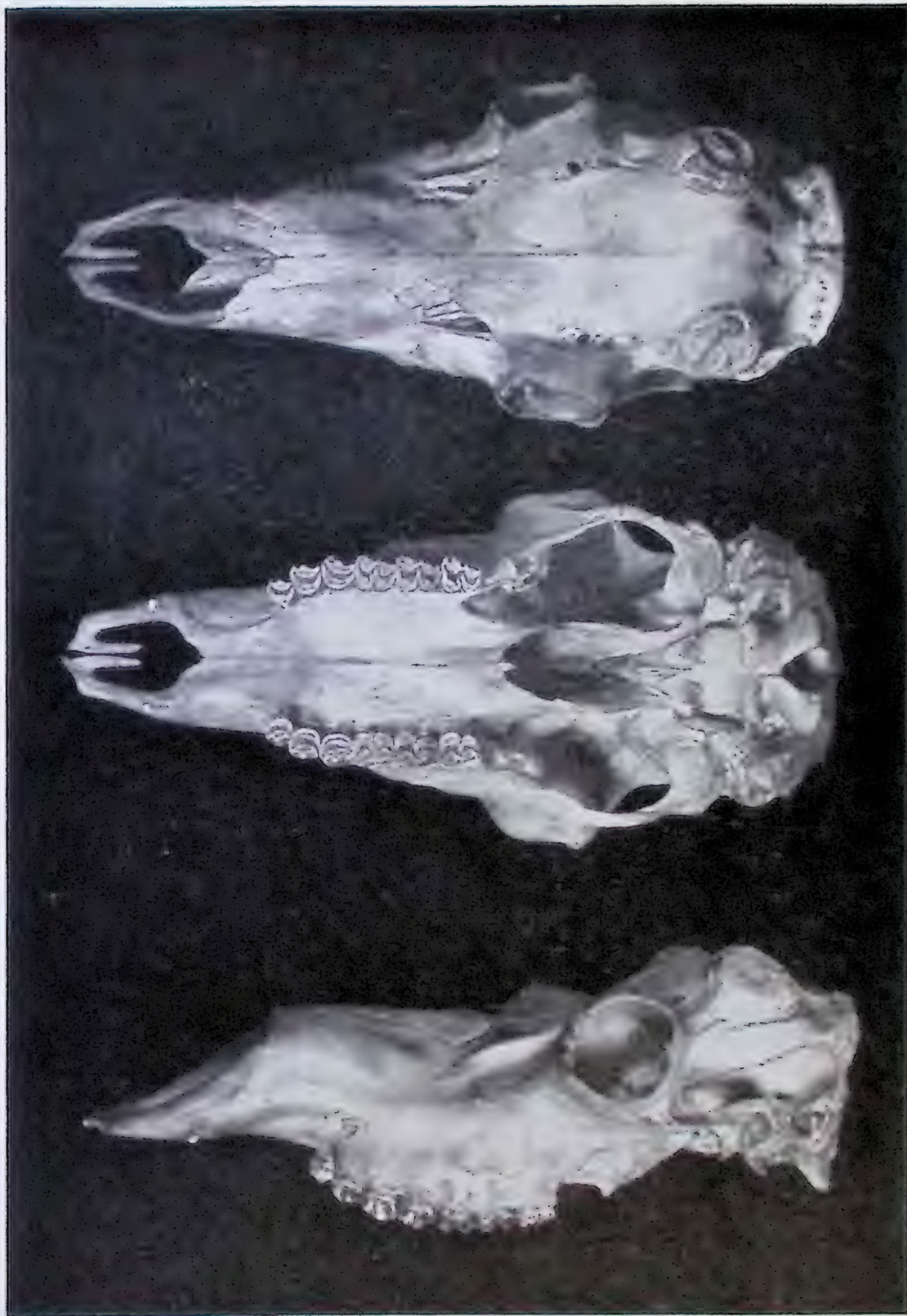
Neotype of *Rangifer tarandus tarandus* (Linné), No. 4661. Naturhistoriska Riksmuseet, Stockholm. Left, ventral view of skull; right, dorsal view of skull. Scale X 0.31.



Neotype of *Rangifer tarandus groenlandicus* (Linné), No. 8831. National Museum of Canada, Ottawa. Top, lateral view of skull, scale X 0.10; bottom left, dorsal view of skull, and bottom right, ventral view of skull, scale X 0.16.



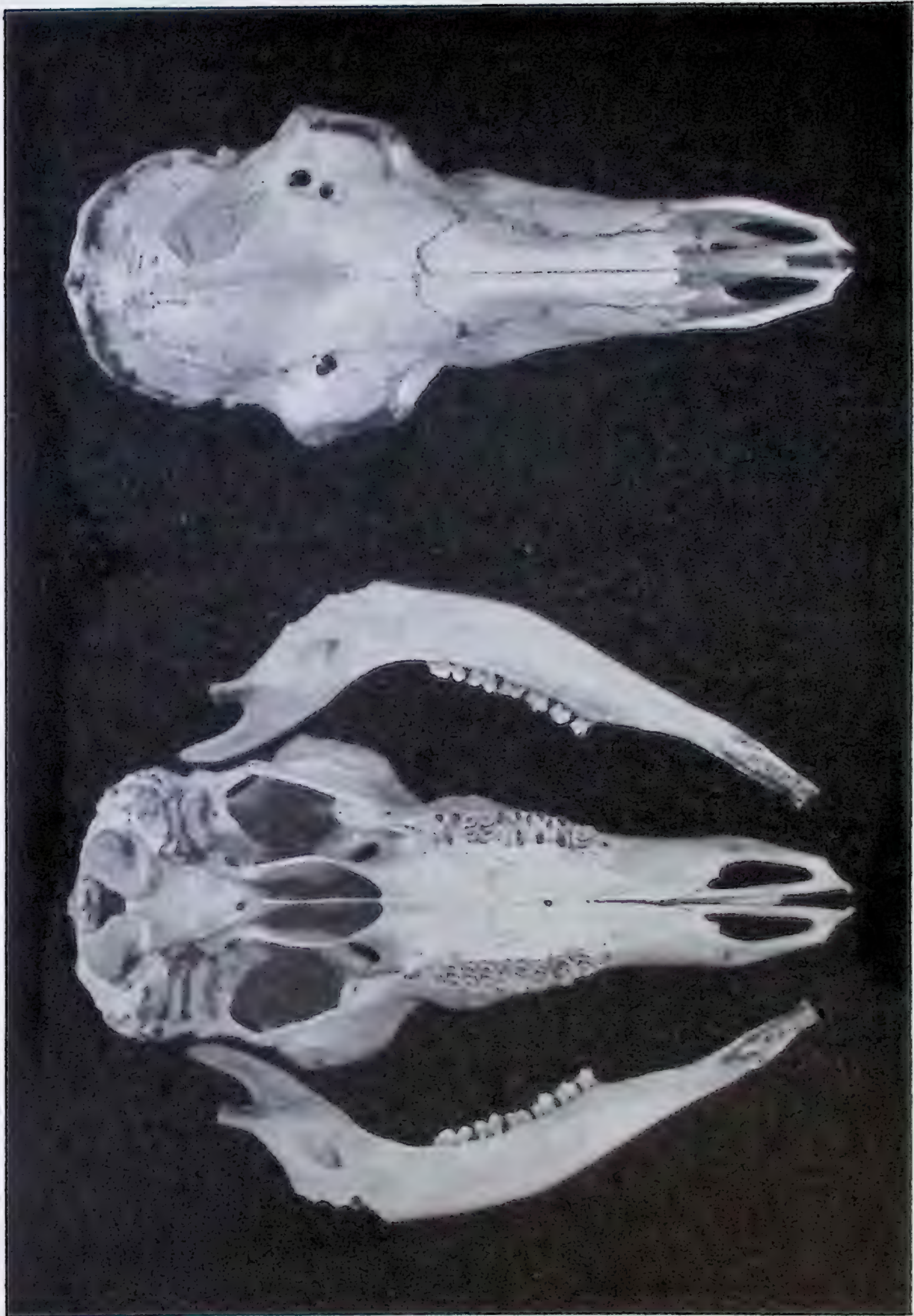
Neotype of *Rangifer tarandus arcticus* Richardson, No. 22066. National Museum of Canada, Ottawa. Top, dorsal view of skull; middle, ventral view of skull; bottom, lateral view of skull. Scale X 0.31.



Neotype of *Rangifer tarandus platyrhynchus* (Vrolik), No. M2625. University of Oslo Zoologisk Museum. Top, dorsal view of skull; middle, ventral view of skull; bottom, lateral view of skull. Scale X 0.30.



Neotype of *Rangifer tarandus caribou* (Gmelin), No. 4800. National Museum of Canada, Ottawa. Top, lateral view of skull, scale X 0.12; bottom left, dorsal view of skull; bottom right, ventral view of skull, scale X 0.22.



Holotype of *Rangifer tarandus fennicus* Lonnberg. No. 809/1960. University of Helsinki Zoological Museum. Top, dorsal view of skull; bottom, ventral view of skull. Scale X 0.20.

**INVESTIGATIONS ON SEA-SHORE INVERTEBRATES OF THE
PACIFIC COAST OF CANADA, 1957 AND 1959
I. STATION LIST**

By E. L. BOUSFIELD

National Museum investigations on the distribution and ecology of intertidal invertebrate animals on the Pacific Coast of Canada, commenced in southern Vancouver Island in 1955 (Bousfield, 1958a), were continued during the summer of 1957 in the Queen Charlotte Islands region, and in 1959 in northern Vancouver Island and adjacent mainland areas. During a total of fifteen weeks in the two regions, more than a thousand miles of coastline were traversed and 128 stations established, about half of which were accessible by automobile and the remainder by chartered boat and light aircraft. As in previous investigations, most of the collecting was done in the intertidal and shallow-water zones of outer shores and estuaries, but fresh-water and terrestrial invertebrate populations were also sampled. A sturdy long-handled dip-net with iron cutting edge was found particularly useful for collecting small arthropods, annelids, molluscs, and other invertebrate assemblages, particularly among fucoids and in eel grass roots along rocky shores, and for straining these animals from sandy and muddy substrata. A small hand strainer effectively sampled the spray pool fauna. Larger items were usually hand-picked. A six-inch Ekman bottom sampler and a three-foot iron frame dredge were operated from shipboard in deeper water. The considerable quantity of material obtained during the two field seasons has been sorted into major systematic groups. Some have already been worked up and included in published studies, e.g., the amphipod families Atylidae and Oedicerotidae (Mills, 1961, 1962) and the fresh-water amphipods (Bousfield, 1958b). Although other taxonomic groups are presently being examined, much material, especially in the smaller phyla, is presently available for study. In order to avoid unnecessary repetition of information in future individual publications and to comply with modern practice (e.g., Bousfield and McAllister, 1962), the station list and maps of station locations are published here.

Initial coverage of such a large and relatively remote coastline in two short seasons could not have been attempted without the assistance of certain regional governmental organizations and interested persons. Work in the Queen Charlotte Islands, particularly along the outer coast, was made possible by the whole-hearted co-operation of the Canadian Department of Fisheries, among whose field officers might be singled out Mr. J. McIntyre at Queen Charlotte City, Captain R. Walker and crew of the "Sooke Post," Captain H. Hedquist and crew of the "Beldis," and Captain J. Hagemann and crew of the "FD 202." The writer joins Mr. Eric L. Mills of Ottawa, who performed very capably as field assistant, in gratefully acknowledging the material assistance, warm hospitality, and many kindnesses extended during the field-work by Dr. Edward Singer and



A. Beds of *Nereocystis* at LW level, exposed rock and sand shore, Station O1, Experiment Bight, Cape Scott, Vancouver I.



B. Intertidal zonation on vertical rock face bordering silt and sand flats, LW level, Station N19, Waddington Harbour, head of Bute Inlet.

Mr. and Mrs. V. Williams of Queen Charlotte City, Mr. and Mrs. R. Ballantyne of Alliford Bay, and Mr. and Mrs. P. Henson, F. Steel, R. Wylie, and Mr. P. Burton, of Masset.

Much of the success of the work in northern Vancouver Island in 1959 was attributable to the co-operation of the Fisheries Research Board at Nanaimo. Special thanks are due Dr. D. B. Quayle for inviting the author to participate in an 8-day work cruise of the C.G.S. "A. P. Knight" to the faunistically rich but geographically remote localities of the north-west coast of the Island. Chartered assistance by Mr. Mel Stauffer and colleagues at Alert Bay, by Mr. Bob Langdon of "Island Airlines" at Campbell River, and by Messrs. William and Peter White at Tofino, and many others, greatly contributed to the scope and efficiency of operations in Queen Charlotte Strait, the large mainland fiords, and the Clayoquot-Nootka coastal regions respectively. It is a pleasure to acknowledge the co-operation and hospitality of Dr. and Mrs. G. Clifford Carl and Mrs. Peggy Whittington in field studies at Long Beach. My wife, Barbara, helped greatly with the beach collecting and colour photography.

RÉSUMÉ

L'auteur a visité cent vingt-huit endroits au cours d'études effectuées pour le compte du Musée national sur la répartition et l'écologie des animaux intercotidaux, dans la région des îles Reine-Charlotte en 1957 et sur le littoral nord de l'île Vancouver en 1959; il a indiqué ces endroits sur la carte et mis en tableau les données recueillies aux diverses stations. Un compte rendu des récoltes d'un nombre restreint de crustacés mais de maintes espèces a déjà paru; il reste à soumettre les autres groupes d'invertébrés à une étude méthodique.

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FIGURE 1. The Pacific Coast of Canada showing principal regions of intertidal investigations:

- (A) Queen Charlotte Islands region, 1957;
- (B) Northern Vancouver Island region, 1959;
- (C) Southern Vancouver Island region, 1955 (after Bousfield, 1956).

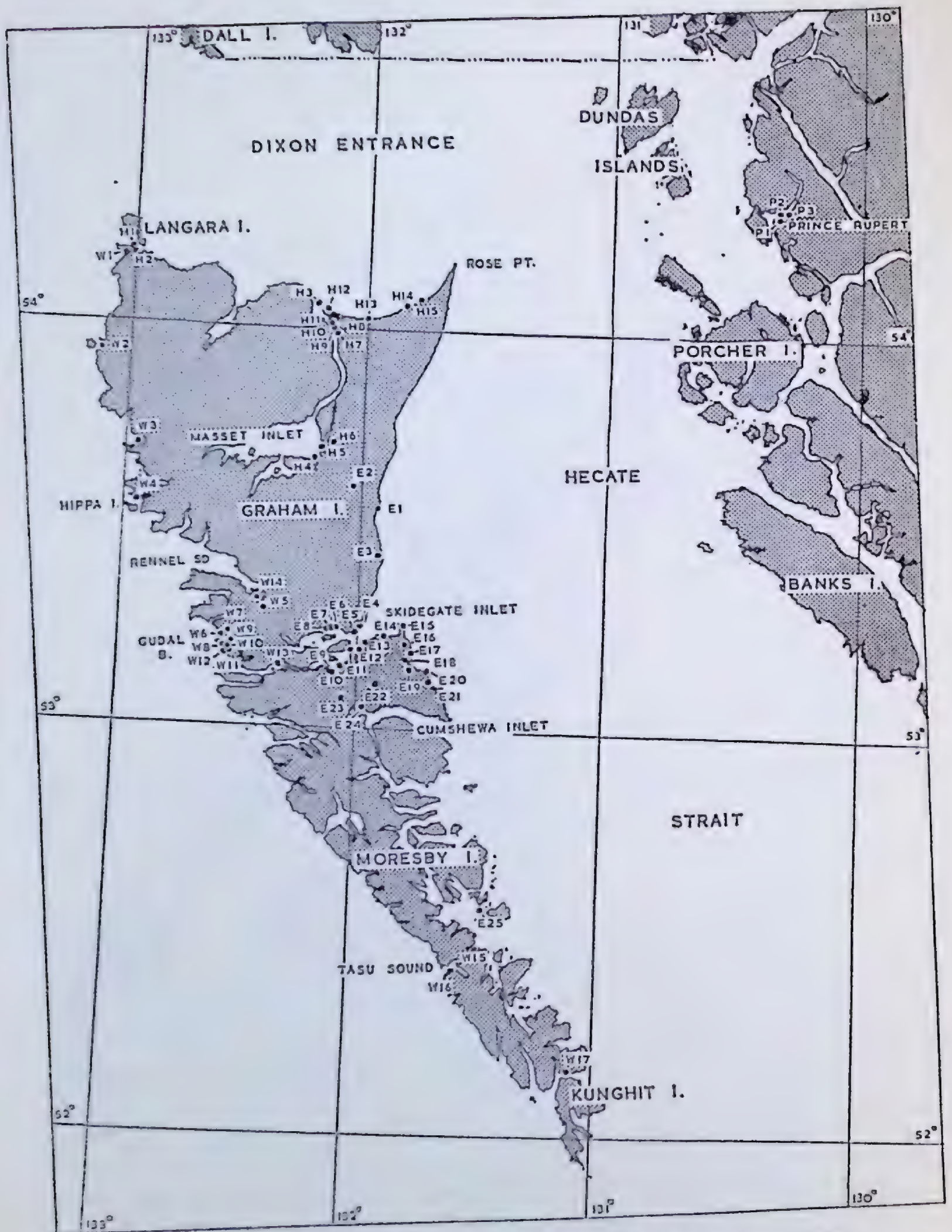


FIGURE 2. Stations visited, Queen Charlotte Islands regions, 1957

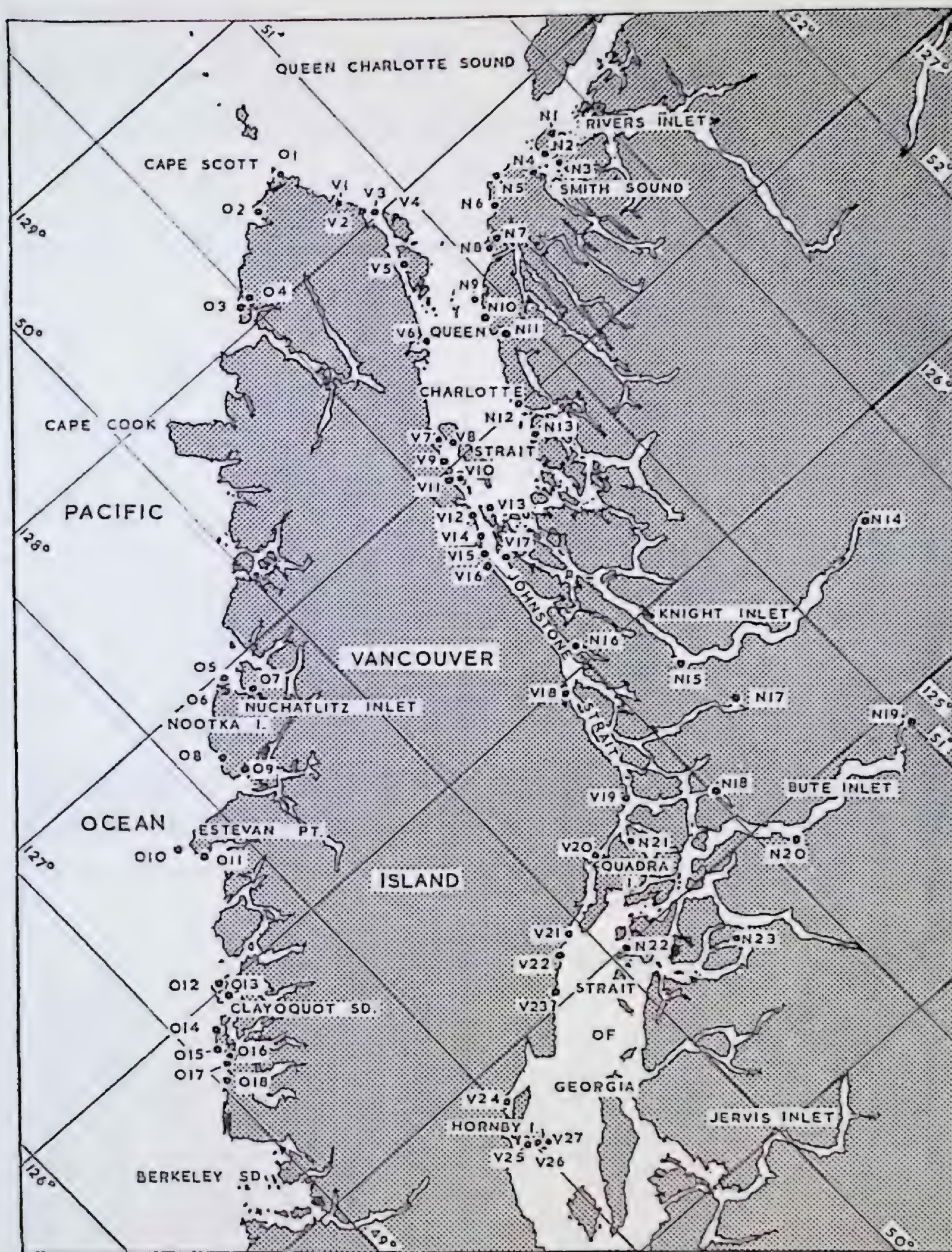


FIGURE 3. Stations visited, Northern Vancouver Island region, 1959

Table I. Localities visited in the Queen Charlotte Islands and adjacent mainland regions, 1957

Legend: P—Prince Rupert area. E—East coast, Queen Charlotte Islands. H—North coast, Q.C.I. W—West coast, Q.C.I.

Sta. No.	Date	Locality	Latitude and Longitude	Habitat	Temp °C	Sal'y ‰
P1	July 3	Morrow stream, above RR tracks., w. end Prince Rupert	54° 18' N 130° 21' W	Stones, woody detritus, grass roots	-	FW
P2	3	Prince Rupert, near mouth of Morrow stream	54° 18' N 130° 21' W	Stones, gravel, mud, fucoids; MW-IIW levels	-	-
P3	3	Hayes Creek, estuary, e. end Prince Rupert	54° 18' N 130° 20' W	Stones, mud flats; LW-IIW levels	-	brackish
E1a	6	Tlell, Graham I., near river mouth	53° 33' N 131° 51' W	Sand, gravel, and stones; LW-IIW levels	15.4	31.6
E1b	6	Tlell, Graham I., opp. Richardson Ranch	53° 33' N 131° 51' W	Sand and woody detritus; LW level	-	-
E2	Aug. 15	Quarry pond, beside Tlell Rd. near Mayer L.	53° 38' N 132° 50' W	Coarse sand; also plankton sample	-	FW
E3	July 6	Lawn Pt., Graham I., small stream, 1 mi. n. of point	53° 26' N 131° 50' W	Pebbles, moss, wood chips	10.2	FW
E4	Aug. 16	Small stream near Jewel I., Skidegate Inlet	53° 16' N 132° 00' W	Stones, moss, woody detritus	-	FW
E5	July 25	Image Pt.; opp. Jewell I., east of Skidegate	53° 15' N 132° 00' W	Slate bedrock, chip gravel, <i>Zostera</i> ; kelps; LW-HW levels	14.2	31.8
E6	Aug. 4	Queen Charlotte City, Graham I.	53° 16' N 132° 04' W	Shale and sandstone, bedrock, intertidal	-	-
E7	17	Stream mouth, W. Queen Charlotte City	53° 16' N 132° 05' W	Pebbles algae, woody detritus	15	FW
E8	Aug. 17	Small stream at Barber's Hotel, Queen Charlotte City	53° 16' N 132° 04' W	Stones, moss	-	FW

E9	July	16	South B., Skidegate Channel	53° 09'N 132° 05'W	Muddy sand and small stones, <i>Zostera</i> ; LW level	14.5	27.0
E10		16	Skidegate Channel, s. of Sandilands I.	53° 10'N 132° 04'W	Muddy sand and eelgrass 20-50 ft., dredge	-	-
E11		16	Alliford B., between Transit I. and shore	53° 12'N 132° 01'W	Mud and shells, 20-30 ft., dredge	-	-
E12		13	Alliford Bay, Moresby I., small stream near plane hangars	53° 12'N 131° 59'W	Moss, grass roots, pebbles	12	FW
E13		14	Kwuna Pt.; n. of Alliford B.	53° 13'N 132° 0'W	HW rock pools	-	-
E14a		13	Onward Pt.; Skidegate Inlet, Moresby I.	53° 14'N 131° 56'W	Slate, sandstone, bedrock, boulders; fucoids and kelp, LW	14.5	32.0
E14b		16	Off Onward Pt.; Skidegate Inlet, Moresby I.	53° 14'N 131° 55'W	Sand and fine gravel, Ekman samples, 15-90 ft.	-	-
E14c		14	Beach opp. Gillatt I., Skidegate Inlet	53° 14'N 131° 54'W	Sand and fine gravel, <i>Zostera</i> ; LW level	14.2	30.6
E15	Aug.	7	Spit Pt., sandspit	53° 15'N 131° 49'W	Coarse sand and shell; HW level	-	-
E16	July	13	Bog pond beside road, s. of Cape Chrouatcheff, Moresby I.	53° 13'N 131° 48'W	<i>Nuphar</i> , organic detritus, pebbles	12	FW
E17	July	11	Copper B., Moresby I. ne. shore at mouth	53° 11'N 131° 47'W	Boulders, bedrock, fucoids; sand, and <i>Zostera</i> ; LW level	13.8	32.3
E18a		11	Copper B., mouth of stream, n. side near head	53° 10'N 131° 49'W	Stones, gravel, woody detritus; MW-HW levels	-	brackish
E18b		11	Copper B., sand beach on n. side	53° 10'N 131° 49'W	Coarse sand; MW-HW levels	-	-
E19		10	Copper B., Moresby I., small pond at head, s. side	53° 09'N 131° 48'W	Organic detritus, aquatic plants	-	FW
E20		12	Dogfish B., Moresby I.	53° 09'N 131° 43'W	Small sand beach at HW level	-	-
E21		12	Gray B., at North Pt., Moresby I.	53° 08'N 131° 43'W	Exposed bedrock and boulders; LW-HW levels	13.8	31.9

Table I. Localities visited in the Queen Charlotte Islands and adjacent mainland regions, 1957—Continued

Legend: P—Prince Rupert area. E—East coast, Queen Charlotte Islands. H—North coast, Q.C.I. W—West coast, Q.C.I.

Sta. No.	Date	Locality	Latitude and Longitude	Habitat	Temp °C	Sal'y ‰
P22	July 10	Skidegate L., ne. shore; Moresby I.	53° 06'N 131° 53'W	Stones, coarse sand, grass roots	-	FW
P23	11	Mosquito L., Moresby I., e. end at old wharf	53° 04'N 132° 04'W	<i>Chara</i> , <i>Nuphar</i> ; logs, woody detritus	14.6	FW
P24	15	Gillatt Arm, Cumshewa Inlet, near Aero, Moresby I.	53° 03'N 131° 59'W	Volcanic bedrock, boulders, muddy gravel, filamentous algae; LW-HW levels	15.1	28.6
P25	Aug. 8	W. end of Hotspring I., Juan Perez Sd., Moresby I.	52° 34'N 131° 26'W	Pebbles, bedrock, kelp at LW level	12.2	31.9
H1	23	Parry Passage; off Kiusta village	54° 10'N 133° 01'W	Sand and shell bottom; Ekman samples in 18-20 ft.	-	-
H2	24	Kiusta Village, Parry Passage	54° 10'N 133° 01'W	Coarse sand, small shells, kelp, <i>Phyllospadix</i> ; LW level	12.4	31.5
H3	27	Mouth of Masset hbr. and McIntyre B.	54° 04'N 132° 13'W	Sand, gravel and shell bottom, 10-70 ft.; dredge hauls	-	-
H4a	19	Yakoun B., mouth of Yakoun R., Masset Inlet	53° 40'N 132° 13'W	Sandy mud, <i>Zostera</i> , filamentous algae; LW level	17.5	brackish
H4b	19	Port Clements, at wharf; Masset Inlet	53° 41'N 132° 11'W	Sandy mud, stones, <i>Zostera</i> , bottom dredge, 4-20 ft.	17.1	21.7
H5	20	Kumdis B., n. of Port Clements	53° 42'N 132° 10'W	Sandy mud, stones and <i>Zostera</i> ; LW to 5 ft. in depth	15.2	-
H6	15	Small lumic stream n. of Port Clements, entering Kumdis Slough	53° 43'N 132° 08'W	Woody detritus and moss	12.5	FW
H7	25	Masset Sd. at B.C. Airlines float	54° 00'N 132° 09'W	Sandy mud bottom; Ekman sample; also wharf pilings	-	-

H8a	26	Delkatla slough; tidal flats above hwy. bridge	54° 01'N 132° 08'W	Mud, sand, <i>Zostera</i> , woody detritus	13	brackish
H8b	25	Delkatla slough, just above hwy. bridge	54° 00'N 132° 08'W	Gravelly sand, mud, <i>Zostera</i> , Ekman bottom samples 5-10 ft.	-	-
H9	23	Masset wharf at mouth of Delkatla slough	54° 01'N 132° 09'W	Mud, coarse sand, stones, <i>Zostera</i> , <i>Phyllospadix</i> ; LW level	12.7	25.5
H10	28	Masset Sd. just n. of Masset wharf	54° 01'N 132° 09'W	Boulders embedded in sand; LW level	-	-
H11	27	Masset hbr. 1/4 mile s. of Old Masset	54° 02'N 132° 10'W	Boulders, sand, <i>Zostera</i> , and fucoids; LW level,	13.6	28.5
H12	26	Old Masset, outer beach	54° 03'N 132° 11'W	Coarse sand and shells; HW level	-	-
H13	4	Mouth of Skonun R., McIntyre B., Graham I.	54° 02'N 132° 00'W	Coarse sand and pebble beach; LW-HW level	-	brackish
H14a	25	Yakan Pt., near Tow Hill, Graham I.	54° 04'N 131° 50'W	Bedrock, boulders, sand, <i>Zostera</i> ; LW-HW	13.6	29.5
H14b	Aug. 25	Yakan Pt., Graham I.	54° 04'N 131° 50'W	<i>Carex</i> marsh above tide level	13.5	FW
H15	4	Tow Hill, McIntyre B.	54° 05'N 131° 47'W	Rock pools at river mouth; HW level	-	brackish
W1	Aug. 23	N. end of Lepas B., Graham I.	54° 10'N 133° 02'W	Sand and bedrock, kelp and <i>Phyllospadix</i> ; LW-HW levels	15.9	31.5
W2	12	Inside Morgan Pt., Peril B., w. coast Graham I.	53° 56'N 133° 07'W	Fine sand, <i>Phyllospadix</i> ; bedrock and boulders; LW-HW	13.5	31.1
W3a	11	Inside Queen Island, Port Louis, Graham I.	53° 41'N 132° 57'W	Stones, gravel, <i>Zostera</i> ; 10-25 ft. dredge	-	-
W3b	11	Port Louis B., Graham I.	53° 41'N 132° 58'W	Surface plankton haul	-	-
W4a	11	Nesto Pt., opp. Hippa I., Graham I.	53° 27'N 132° 48'W	Fine shell, boulders, bedrock, <i>Phyllospadix</i> ; LW level	14.6	32.2
W4b	Aug. 10	N. shore Hippa Passage, inside Marchand Pt., Graham I.	53° 27'N 132° 58'W	Gravel, stones and shells, 20-30 ft., dredge	-	-

Table I. Localities visited in the Queen Charlotte Islands and adjacent mainland regions, 1957—Concluded

Legend: P—Prince Rupert area. E—East coast, Queen Charlotte Islands. H—North coast, Q.C.I. W—West coast, Q.C.I.

Sta. No.	Date	Locality	Latitude and Longitude	Habitat	Temp °C	Sal'y ‰
W5a	Aug. 10	Hd. of Shields B. at mouth of Mountain Ck.	53° 18'N 132° 25'W	Stones, filamentous algae; LW level	16	-
W5b	10	Hd. of Shields B. at mouth of Mountain Ck.; Mountain Ck.	53° 18'N 132° 25'W	Stones, fast current	11	FW
W6	July 29	Stiu Pt., at mouth of Stiu Ck.; Graham I.	53° 14'N 132° 36'W	Bedrock spray pools	-	brackish
W7	29	Mouth of Stiu L., near Van Inlet	53° 15'N 132° 36'W	Stones, gravel, woody detritus	14	FW
W8	28	Gudal B. hd. of North Arm	53° 14'N 132° 04'W	Stones, gravel, bedrock pools, Laminarians and <i>Phyllospadix</i> ; LW-HW levels	11.9	29.6
W9a	26	Hd. of Gudal B. at stream mouth	53° 14'N 132° 04'W	Sand, bedrock, kelp, <i>Phyllospadix</i> ; LW level	11.2	29.3
W9b	26	Hd. of Gudal B. at stream mouth	53° 14'N 132° 04'W	HW rock pools	-	brackish
W10	28	Lower Gudal L.	53° 14'N 132° 03'W	Woody detritus, pebbles, logs, <i>Nuphar</i>	14	FW
W11	28	Hd. of Gudal B., s. side, w. coast Graham I.	53° 14'N 132° 03'W	Sand, boulders, kelp and <i>Phyllospadix</i> ; LW level	9.6	23.3
W12a	29	S. side Gudal B., near the mouth	53° 13'N 132° 04'W	Wave-worn bedrock, boulders, kelp and <i>Phyllospadix</i> ; LW level	11.5	-
W12b	27	Gudal B., s. side	53° 13'N 132° 04'W	Surface plankton tow	-	-
W12c	27	Gudal B., s. side, HW pools at stream mouth	53° 13'N 132° 04'W	Bedrock pools	13	brackish FW

W13	Aug.	1	Skidegate Channel, at Downie I.	53° 09'N 132° 21'W	Stony and rocky shores; LW level	-	-
W14		9	Clonard B., Rennell Id., at head	53° 20'N 132° 30'W	Algae and stones, 20-40 ft., dredge	-	-
W15		9	Two Mountain B., Tasu Id.	52° 48'N 132° 00'W	Gravel, shell, <i>Zostera</i> , bedrock; LW level	14.0	-
W16		9	Horn Rock, Tasu Id.	82° 46'N 132° 03'W	Bedrock, kelp, <i>Phyllospadix</i> ; LW-HW levels	-	-
W17		8	Houston Stewart Channel, 1 mi. e. of Cape Fanny	52° 07'N 131° 09'W	Sand, gravel, rock pools, HW level	12.3	brackish

Table II. Localities visited in North Vancouver Island and adjacent mainland regions, 1959

Legend:— O — outer Coast, Vancouver Island. V — Vancouver Island, inner coast N — Mainland coast

Sta. No.	Date	Locality	Latitude and Longitude	Habitat	Temp °C	Sal'y ‰
O1	July 18	Experiment Bight, Cape Scott, V.I.	50° 40'N 128° 20'W	Fine sand and rock, <i>Phyllospadix</i> ; LW-HW levels	12.0	-
O2a	18	Sea Otter Cove, Vancouver I. Mouth, w. side	50° 40'N 128° 21'W	HW rock pools	-	-
O2b	18	Sea Otter Cove, V.I.; inside Hanna Pt.	50° 40'N 128° 21'W	Dredge haul on stony bottom	12.8	33.0
O2c	18	San Josef B., V.I.; river mouth at head	50° 40'N 128° 17'W	Fine sand bar and beach	-	-
O3	21	Grant B., V.I.; entrance to Quatsino Sd.	50° 29'N 128° 06'W	Coarse sand, shells, bedrock; LW-HW levels	11.8	33.0
O4	19	Browning Inlet, Quatsino Sd.	50° 30'N 128° 06'W	Sand, shell, eel grass, pitted bedrock; LW-HW levels	15.4	-
O5	20	Ferrer Pt. beach, V.I.	49° 45'N 126° 58'W	Fine sand, bedrock, kelp, <i>Phyllospadix</i> ; LW-HW levels	13.5	32.2
O6	19	Louis B., lagoon, Nootka I.	49° 44'N 126° 56'W	Fine sand, shell and eelgrass flats; LW level	21.0	-
O6a	19	Louis B., off Ferrer I.	49° 45'N 126° 56'W	Sand bottom, 10 fm; Peterson grab.	16.5	-
O7a	Aug. 20	Nuchatlitz Inlet. Nootka I., Inner Basin	49° 48'N 126° 49'W	Gravel, <i>Zostera</i> ; LW-HW levels	14.5	31.7
O7b	Aug. 20	Small island at the Narrows, Nuchatlitz Inlet, V.I.	49° 48'N 126° 50'W	Bedrock walls, coarse sand; LW level	15.0	-
O7c	20	The Narrows, Nuchatlitz Inlet	49° 48'N 126° 50'W	Small sand beach at HW level	-	-

O7d	19	Small island off Benson Pt., Nuchatlitz Inlet	49° 47'N 126° 52'W	Stones, 12-24 ft; bottom dredge	-	-
O8	19	Skuna B., at Cascade, Nootka I.	49° 36'N 126° 42'W	Fine sand beach at HW; HW rock pools	-	FW
O9	19	Nootka, at Fish Camp, Nootka I., V.I.	49° 37'N 126° 37'W	Stones and bedrock, stream mouth; HW level	-	FW
O10	19	Off Estevan Pt., V.I.	49° 22'N 126° 34'W	Surface, dip net sample	-	-
O11	19	Hesquiat, at Matlakaw Pt., V. I.	49° 23'N 126° 28'W	Boulders, gravel, shale, kelp, <i>Phyllospadix</i> ; LW level	15.0	31.3
O12	18	Ahous B., Vargas I., V.I.	49° 11'N 126° 01'W	Fine sand, bedrock, <i>Phyllospadix</i> ; LW level	12.8	31.6
O13	17	Yarksis, Vargas I., V.I.	49° 11'N 125° 58'W	Fine sand beach, shell and debris at LW level	13.0	31.5
O14	16	Chesterman Beach, near Clayoquot Light, V.I.	49° 07'N 125° 52'W	Fine sand beach, HW rock pools	-	-
O15	16	Box I., n. end Wickaninnish B., V.I.	49° 04'N 125° 48'W	Bedrock; fine sand, <i>Phyllospadix</i> ; kelp, LW level; also HW pools	15.0	31.3
O16	14	Singing Sands Beach, Wickaninnish B., V.I.	49° 04'N 125° 15'W	Fine sand; LW- $\frac{1}{2}$ R., surf shore	15	-
O17	13, 15	Midway Rocks, Wickaninnish B., V.I.	49° 03'N 125° 14'W	MW-HW rock pools, exposed rock faces	15	-
O18	13, 15	Webb's Rocky Pt., se. end Wickaninnish B.	49° 01'N 125° 41'W	MW-HW rock pools, fine sand at LW level	-	-
V1	6	Shuttleworth Bight, w. side, N. Vancouver I.	50° 50'N 128° 09'W	Sand and pebble beach; HW level	-	-
V2	6	Cape Sutil beach, n. end Vancouver I.	50° 52'N 128° 03'W	Fine to coarse sand; HW level	-	-
V3	July 17	Nahwitti Bar, entrance to Goletas Channel, B.C.	50° 55'N 128° 02'W	Sand, stones and shell, 6-40 fm, dredge	-	-
V4a	21	Roller B., Hope I.	50° 56'N 127° 56'W	Bedrock pools and coarse sand beach; HW level	-	-

Table II. Localities visited in North Vancouver Island and adjacent mainland regions, 1959—Continued

Legend:—O—outer Coast, Vancouver Island. V—Vancouver Island, inner coast N—Mainland coast

Sta. No.	Date	Locality	Latitude and Longitude	Habitat	Temp °C	Sal'y ‰
V4b	22	Roller B., Hope I.	50° 56'N 127° 56'W	Boulders, bedrock, gravel, and coarse sand; <i>Phyllospadix</i> , kelp; LW level	10.4	32.6
V5	Aug. 6	Nigei I., at Lemon Pt., Goletas Channel	50° 51'N 127° 46'W	Boulders, stones, <i>Corallina</i> , furoids, <i>Phyllospadix</i> ; LW level	11.4	—
V6	July 22	Hardy B., off Duval I.	50° 45'N 127° 28'W	Sand bottom, 80 fm, dredge	—	—
V7	Aug. 7	Lady Ellen Pt., Broughton Str., V.I.	50° 36'N 127° 07'W	Rocks, medium sand, <i>Zostera</i> , kelp; LW level	11.5	—
V8	7	W. side Rough B., Malcolm I., Broughton Str.	50° 37'N 127° 05'W	Stony and mossy stream mouth	—	—
V9	Aug. 7	Hyde Ck., V.I., opp. Haddington I.	50° 35'N 127° 01'W	Stones gravel; MW-HW levels	—	brackish
V10	1	Alert B., Cormorant I., Broughton Str.	50° 35'N 126° 56'W	Muddy sand, gravel, stones, kelp; LW-MW levels	11.1	30.1
V11	7	Broughton Str., e. of mouth of Nimpkish R., V.I.	50° 34'N 126° 57'W	Coarse sand, <i>Zostera</i> ; <i>Ulva</i> , kelp; LW level	11.3	—
V12	4	Bauza Cove, Broughton Str., Vancouver I.	50° 33'N 126° 49'W	Gravel beach; MW-HW levels	—	—
V13	5	Double B., w. end of Hanson I.	50° 35'N 126° 46'W	Stones and detritus; MW-HW levels	—	brackish
V14	4	Kaikash Ck., V.I., opp. e. end Hanson I.	50° 31'N 126° 41'W	Stones, woody detritus	9.5	fresh to low brackish
V15	5	Big Creek B., V.I.	50° 30'N 126° 37'W	Small stream, stony bed	10.4	FW

V16	5	Robson Bight, V.I., opp. Cracroft I.	50° 29'N 126° 35'W	Under boulders, stream mouth, supratidal	10	FW
V17	5	Boat B., Cracroft I., Johnstone Str.	50° 32'N 126° 34'W	Coarse sand, stones, bedrock, eelgrass; LW-HW levels	10.2	31.1
V18	June 24	Kelsey B., V.I.	50° 24'N 125° 57'W	Coarse sand, pebbles, eelgrass, bedrock; LW level	10.5	28.9
V19	26	Rock B., V.I., e. end Johnstone Str.	50° 21'N 125° 29'W	Fine sand, gravel, stones, kelp and fucoids; LW level	10.2	29.9
V20	22	Brown B., V.I.	50° 09'N 125° 23'W	Stones, coarse sand, bedrock, kelp; LW-HW levels	10.7	28.8
V21	July 28	Simms Ck., s. of Campbell R., B.C.	49° 48'N 125° 13'W	Coarse sand, stones, woody detritus; MW-HW levels	15.7	brackish to FW
V22	June 21	Oyster B., V.I.	49° 55'N 125° 11'W	Sand flats, pebbles, <i>Zostera</i> ; LW-HW levels	16.8	27.7
V23	21	Miracle Beach, V.I.	49° 51'N 125° 6'W	Sand flats, pebbles LW-HW levels	-	-
V24	July 29	Buckley B. at ferry landing; Str. of Georgia	49° 32'N 124° 50'W	Cement piers at LW level	18	-
V25	30	Little Tribune B., Hornby I., Str. of Georgia	49° 31'N 124° 39'W	Fine sand, detritus at HW level	-	-
V26	30	Tribune B., Hornby I., Str. of Georgia	49° 32'N 124° 38'W	Hard-packed fine sand and drift; HW levels	-	-
V27	31	Whaling Station B., Hornby I., Str. of Georgia	49° 32'N 124° 36'W	Fine white sand, sandstone, <i>Sargassum</i> ; LW-HW levels	17.2	27.2
N1	Aug. 3	Open Bight, Rivers Inlet, B.C.	51° 22'N 127° 47'W	Bedrock, coarse sand, shell, <i>Phyllospadix</i> and kelp; LW-HW levels	9.8	32.2
N2	2	Millbrook Cove, Smith Id.	51° 20'N 127° 44'W	Stones, shells, moss, woody detritus; LW level	-	-
N3	2	Smith Id., inside Cathcart I.	51° 20'N 127° 38'W	Fine sand beach under logs and <i>Zostera</i> drift; HW level	-	-
N4	3	Smith Id., s. side opp. Searcher I.	51° 17'N 127° 40'W	Fine sand, MW-HW levels, stream mouth	-	-

Table II. Localities visited in North Vancouver Island and adjacent mainland regions 1959—Concluded

Legend:— O — outer Coast, Vancouver Island. V — Vancouver Island, inner coast N — Mainland coast

Sta. No.	Date	Locality	Latitude and Longitude	Habitat	Temp °C	Sal'y ‰
N5a	2	Neck Ness Pt., mouth of Bertha R.	51° 12'N 127° 47'W	Stones and organic debris; HW level	—	brackish
N5b	Aug. 2	Blunder B., n. of Cape Caution	51° 11'N 127° 47'W	Fine sand; HW level	—	—
N6	2	Bremner Beach, Raynor Pt., B.C.	51° 08'N 127° 41'W	Fine sand; boulders, <i>Phyllospadix</i> and kelp; LW-HW levels	10.0	32.4
N7	1	Overnight Cove, Bramham I., Slingsby Channel, B.C.	51° 05'N 127° 34'W	Stones and organic debris, supratidal levels	22.5	FW
N8	3	Miles Inlet, Bramham I.	51° 04'N 127° 34'W	Bedrock cliff faces; HW level	—	—
N9	3	Dickenson Rocks, off Allison Hbr.	51° 01'N 127° 35'W	HW and supratidal rock pools	—	—
N10	1	Mouth of Parnell Ck., Richards Channel, B.C.	50° 56'N 127° 24'W	Gravel and boulders; HW level	16	brackish
N11	4	Port Progress, n. side Queen Charlotte Str.	50° 55'N 127° 16'W	Sandy mud, shell stones, <i>Zostera</i> ; LW level	11.3	30.7
N12	4	Kenneth B., mouth of Wells Passage	50° 50'N 127° 01'W	Stones, clay silt, organic detritus; MW-HW levels	—	brackish
N13	4	Dobbin B., Broughton I.	50° 47'N 126° 48'W	Stones and silty clay at stream mouth; HW and supratidal levels	—	FW to brackish
N14	June 25	Dutchman Head, Knight Inlet	51° 05'N 125° 35'W	Fine silt, fucoids on bedrock walls; LW-HW levels	12.2	fresh to taste
N15	25	Glendale Cove, w. shore Knight Inlet	50° 40'N 125° 45'W	Mud and shell, fucoids on stones; LW-MW levels	14.7	brackish to taste

N16	July 17	Port Neville, Johnstone Str., B.C.	50° 29'N 126° 05'W	Sand, muddy sand, <i>Zostera</i> , kelp; LW-HW levels	10.4	31.4
N17	June 25	Fraser B., w. shore, hd. of Loughborough Inlet	50° 43'N 125° 28'W	Coarse sand, stones, woody detritus, <i>Fucus</i> on rocks; LW-MW levels	9.3	0.7
N18	June 23	Estero Channel, hd. of Frederick Arm, B.C.	50° 30'N 125° 15'W	Coarse sand, pebbles, shell, wood chips; LW-MW levels	12.3	12.8
N19	23	Waddington Hbr., hd. of Bute Inlet	50° 56'N 124° 51'W	Silty sand and clay, bedrock faces; LW-HW levels	10.0	fresh
N20	23	Oxford B., e. side of Bute Inlet	50° 36'N 124° 51'W	Coarse sand flats, gravel, woody detritus; MW level	10.8	1.1
N21	23	Kamish B., Quadra I., hd. of n.e. Arm	50° 16'N 125° 17'W	Coarse sand, mud, small stones and shell; LW-HW levels	15.5	28.6
N22	20	Manson's Landing, Cortez I.	50° 04'N 124° 59'W	Coarse sand, boulders, shells; LW-HW levels	18.3	25.6
N23a	July 16	Hd. of Pendrell Sd.; E. Redonda I., B.C.	50° 18'N 124° 40'W	Rock, shell, stones; LW-HW levels	23.8	brackish
N23b	23	Hd. of Pendrell Sd.	50° 18'N 124° 40'W	Small stones, mud, 80 fm, dredge	-	-

ARCTIC ARCHIBENTHAL AND ABYSSAL MOLLUSCS—II
MOLLUSCS DREDGED FROM DRIFTING
STATION CHARLIE (ALPHA II)*

By ARTHUR H. CLARKE, JR.

INTRODUCTION

This report is based on material dredged in 1959 and 1960 from Station Charlie (also called Alpha II), a drifting arctic ice-floe manned by scientists from the Lamont Geological Observatory, Columbia University. During the collecting period the station drifted in the vicinity of the western flank of the Chukchi Rise in the North Canadian Basin about 800 miles north of Bering Strait. Published reports on scientific activities relating to Station Charlie are by Cromie (1960) and Huggins, *et al.* (1962).

The molluscs collected were taken in nine bottom samples from depths of 290 to 1,245 fathoms (see Tables 1 and 2). At each station a trawl one metre wide was used, and the bottom was found to be composed of mud and rocks. A total of 2,068 specimens representing one species of scaphopod, 12 of gastropods, and 11 of pelecypods were dredged. One of the gastropod species appears to be new, and several of the other finds represent substantial extensions of known bathymetric and geographic ranges of the species involved. Only 37 specimens (1.8%) occurred alive, but these included representatives of nine species. Bottom photographs (see Cromie, 1960) made during the drift of Station Charlie have shown that many other benthic invertebrates also populate the Chukchi Rise and the deep area west of the Rise.

Previous papers on the archibenthal and abyssal molluscs of the North Canadian Basin are by Gorbunov (1946*a* and *b*), Scarlato (in Brodskii and Nikitin, 1955), Filatova (1959 and 1962), Clarke (1960), and Wagner (1962). Important papers dealing with molluscs from shallow depths in this region are by Soot-Ryen (1932) and MacGinitie (1959). The paper by Scarlato is based on molluscs dredged from the Russian Scientific-Research Drifting Station of 1950-51 which also drifted in the vicinity of the Chukchi Rise. As such, it is of special interest in the present study. A tabular summary of that paper is given in Clarke (1960).

Copies of the papers by Gorbunov are rare and, in general, have been overlooked by workers in North America and Western Europe. His studies are based on collections made between 1935 and 1938 by the Sadko and Sedov expeditions near the New Siberian Islands. One hundred and sixty-eight species, subspecies and "varieties" of molluscs, including eight new species, were reported from depths ranging from 10 to 2,080 fathoms. For the convenience of workers who lack access to Gorbunov's papers, figures of his new species are reproduced in Plate I.

* The first paper in this series was concerned with the molluscs dredged from arctic drifting Station Alpha. See *Breviora*, No. 119, 1960.

TABLE 1. Station Charlie bottom samples which yielded molluscs

Trawl No.	Depth		N. Lat.	W. Long.	Date	Time Towed	
	fm	m				hr.	min.
2	1,132	2,069	77°42'	171°04'	6 Nov. 1959	4	55
3	1,240	2,250	77°52'	172°34'	25 Nov.	4	45
4	1,245	2,237	77°39'	172°43'	30 Nov.-1 Dec.	6	5
5	1,210	2,212	76°51'	171°01'	11-12 Dec.	2	53
8	296	540	77°13'	168°12'	20-21 Dec.	4	40
9	320	584	77°14.5'	168°35'	23 Dec.		31
10B	389	711	77°14.2'	167°50'	24 Dec.		33
12	290	530	77°12'	167°44'	2 Jan. 1960	4	58
15	1,085	1,984	77°00'	168°47'	6 Jan.	6	57

ACKNOWLEDGMENTS

Dr. Kenneth Hunkins of the Lamont Geological Observatory, Columbia University, collected the specimens treated in this report (under contract AF19 (604) 2030 with the Geophysics Research Directorate, United States Air Force Cambridge Research Center) and generously submitted them to the writer for identification and report. Preliminary sorting was performed by Mr. Donald Robinson of the Lamont Geological Observatory.

The writer is indebted to several curators and other workers for permitting him access to their collections in order to facilitate identification of the more difficult species. These are: Dr. W. J. Clench, Museum of Comparative Zoology, Harvard University; Dr. Fritz Haas, Chicago Natural History Museum; Dr. Henry van der Schalie, University Museums, University of Michigan; Dr. Henning Lemche and Dr. Jørgen Knudsen, Zoological Museum, University of Copenhagen; Dr. E. Fischer-Piette and Dr. J.-M. Gaillard, Muséum National d'Histoire Naturelle, Paris; and Mr. Norman Tebble, Mr. S. P. Dance, and Mr. J. F. Peake, British Museum (Nat. Hist.). Thanks are also expressed to Dr. Joseph Rosewater, United States National Museum, for the identification of *Oenopota inequita* Dall and for examining the species of *Alvania* here reported.

TABLE 2. *Molluscs from bottom samples taken from Station Charlie*Abbreviations: a = living specimens; sh = shells only; $\frac{x}{2}$ = x valves (bivalve species)

Sample No. Depth (fm)	12 290		8 296		9 320		10B 389		15 1085		2 1132		5 1210		3 1240		4 1245	
	a	sh	a	sh	a	sh	a	sh	a	sh	a	sh	a	sh	a	sh	a	sh
<i>Alvania karlini</i> n.sp.....	1	-	-	2	-	3	-	-	-	-	-	-	-	6	-	-	12	sh
<i>Alvania wyvillethomsoni</i> Friele..	-	1	-	4	-	1	-	3	-	-	-	-	-	2	-	-	2	-
<i>Tachyrhynchus reticulatum</i> Migh.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
<i>Turritellopsis acicula</i> Stimp....	-	-	-	-	-	-	-	2	-	-	-	-	-	2	-	-	1	sh
<i>Natica clausa</i> Brod.+Sby.....	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Polinices pallidus</i> Brod.+Sby..	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	sh
<i>Naticidae</i> (fragmentary).....	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	sh
<i>Velutina undata</i> Brown.....	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	sh
<i>Colus hunkinsi</i> Clarke.....	-	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Buccinidae</i> (fragmentary).....	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
" <i>Oenopota</i> " (<i>inequata</i> Dall (?))..	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
" <i>Oenopota</i> " (<i>pyramidalis</i> Strøm..	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Cylichna alba</i> Brown.....	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	sh
<i>Siphonodentalium lobatum</i> Sby..	-	2	-	13	-	2	-	55	-	-	-	-	-	28	-	11	2	sh
<i>Nucula zophos</i> Clarke.....	2	14	-	13	-	2	2	58	1	2	-	-	1	2	-	-	2	-
<i>Malletia abyssopolaris</i> Clarke...	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
<i>Ledella tamara</i> Gorbunov.....	-	2	-	1	-	1	2	27	-	1	-	21	1	147	-	12	-	31
<i>Portlandia frigida</i> Torell.....	1	2	1	1	-	-	3	10	-	-	-	4	-	86	-	4	3	13
<i>Portlandia intermedia</i> Sars.....	-	-	-	-	-	-	-	-	-	-	1	123	-	407	1	190	-	290
<i>Bathyarca frielei</i> Friele.....	-	1	1	2	-	-	4	12	-	19	-	19	3	71	-	16	2	29

SYSTEMATICS

Family RISSOIDAE

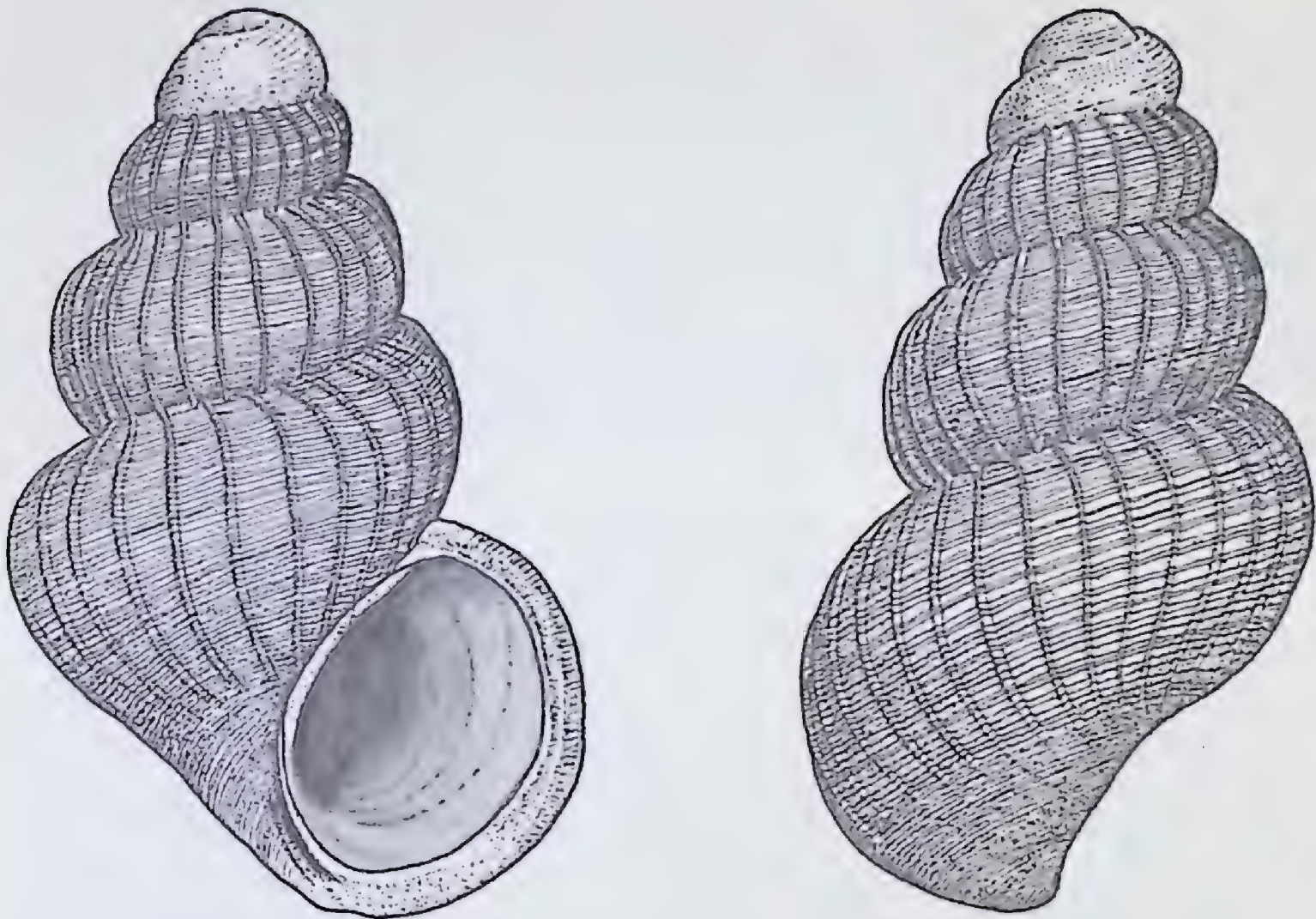
Alvania karlini n. sp.

(Text Figure 1)

Description. Shell small ($\frac{1}{8}$ inch), conical, whitish, rather thin, and moderately sculptured. Whorls $4\frac{3}{4}$, convex, rounded, and with deeply impressed sutures. Sculpture consisting of numerous axial ribs (28 on the body whorl and 28 on the penultimate whorl) on all but the nuclear whorls and numerous fine, impressed, revolving lines on all whorls. Ribs becoming poorly defined on the base of the body whorl. Impressed lines about eight on the tip of the protoconch increasing to about 30 on the penultimate whorl and to about 70 on the body whorl (including the base). Spine produced at an angle of approximately 40 degrees. Aperture ovate. Outer lip thickened and finely crenulated. Columellar lip slightly thickened and separated from the body whorl by a groove. Colour white to pale yellowish-brown. Operculum not seen.

	<u>Height</u>	<u>Width</u>	<u>Number of Whorls</u>
	mm	mm	
Holotype (sample 12)	3.2	2.0	$4\frac{3}{4}$
Paratype (sample 9)	3.0	1.8	$4\frac{2}{3}$
Paratype (sample 5)	2.9	1.6	$4\frac{2}{3}$
Paratype (sample 4)	2.5	1.6	$4\frac{1}{3}$
Paratype (sample 3)	2.5	1.5	$4\frac{1}{2}$

Types. The holotype was collected alive in sample 12 (290 fathoms, 77° 12' N, 167° 44' W, on the western edge of the Chukchi Rise, North Canadian Basin, Arctic Ocean) and is No. 7032 in the National Museum of Canada. Paratypes from samples 3, 4, 5, 8, and 9 are also in the National Museum of Canada. Only the holotype appears to have been alive when collected.



TEXT FIGURE 1. *Alvania karlini* n. sp., holotype, Station Charlie sample 12

Remarks. *Alvania karlini* is somewhat similar to *A. abyssicola* (Forbes), *A. jeffreysi* (Waller), *A. reticulata* (Montagu), and some other species, but differs from all of them in sculpture. It is closer to specimens in the British Museum (Nat. Hist.) labelled *A. stefanisi* (Jeffreys) than to any other *Alvania* seen but differs in that the whorls in *stefanisi* are flattened, but in *karlini* they are rounded. In addition, *stefanisi* has flat-topped ribs; in *karlini* the ribs are triangular in cross-section and rounded apically.

This species is named in honour of the late Dr. Edward J. Karlin, formerly of Bowling Green University, Bowling Green, Ohio. Slugs and other terrestrial molluscs were his special interest, and he was a careful and productive worker and a good friend. His premature death was an irreparable loss to his colleagues and to malacology.

***Alvania wyvillethomsoni* (Friele)**

Rissoa wyville-thomsoni (Jeffreys MS.) Friele, 1877: *Nyt Magazin for Naturvidenskaberne* 23: 3. Figured by Thorson, 1944, *Medd. om Grønland* 121 (13): 38.

Thorson (1944: 38) has given the known geographic and bathymetric range of *A. wyvillethomsoni* as East Greenland and Iceland to Spitsbergen and the arctic coast of Norway from 95 to 2,814 m (52–1,539 fm). Gorbunov (1946a) has also recorded it from eleven stations along the arctic coast of Russia from near Novaya Zemlya to off the New Siberian Islands in 65 to 1,125 m (36–615 fm). During the present study a total of nine dead specimens occurred in four samples on the western edge of the Chukchi Rise in depths of 290 to 389 fathoms. Although *A. wyvillethomsoni* was not recorded from Point Barrow by MacGinitie (1959), the species apparently occurs throughout the entire Arctic Ocean in the sublittoral and archibenthal and in the Norway Basin of the North Atlantic from the sublittoral to the abyssal.

Family TURRITELLIDAE

***Tachyrhynchus reticulatum* (Mighels)**

Turritella reticulata Mighels (in Mighels and Adams), 1841, *Proc. Boston Soc. Nat. Hist.* 1: 50; Mighels and Adams, 1842, *Boston J. Nat. Hist.* 4 (1): 50, pl. 4, fig. 19.

Two dead specimens of *T. reticulatum* occurred in sample 5 (1,210 fm) and two occurred in sample 4 (1,245 fm). This shallow-water species (2–152 fm) has been recorded from localities ranging from Greenland to Maine and from Point Barrow, Alaska, to the Aleutians and British Columbia (MacGinitie, 1959; Thorson, 1944). Gorbunov's record of *T. erosus* var. *costatus* Aurivillius from 25 fathoms near the New Siberian Islands may also represent this species. The present specimens were probably transported from shallow water by ice.

***Turritellopsis acicula* (Stimpson)**

Turritella acicula Stimpson, 1851, *Shells of New England*, p. 35, pl. 1, fig. 5.

Turritellopsis (acicula variety) stimpsoni Dall, 1919, *Proc. U.S. Nat. Mus.* 56 (2295): 347 (new name for *Turritellopsis acicula* Stimpson of Sars, 1878, *Mollusca Regiones Acticae Norvegiae*, p. 186, pl. 10, fig. 14).

Turritellopsis acicula stimpsoni Dall, 1921, *U.S. Nat. Mus., Bull.* 112, p. 152; La Rocque, 1953, *Nat. Mus. Canada, Bull.* 129, p. 172.

Dall (1919) stated that the figures in Stimpson (*acicula* s.str.) and in Sars (=var. *stimpsoni*) were significantly different in that: "*T. acicula* is more slender, with a looser coil and a much more constricted suture. It has three strong spiral cords while *T. stimpsoni* has five to seven." Localities for *acicula* were given as Newfoundland, Grand Manan, and Portland, Maine, and localities for *stimpsoni* were given as Maine, Lofoten, Spitsbergen, and from Nunivak Island, Alaska, to San Diego, California.

A comparison of the figures of Stimpson and of Sars does not bear out the differences cited by Dall. Stimpson's figure shows three major cords on the early whorls increasing to five on the final whorl while Sars' figure

shows three cords increasing to about six. Stimpson's figure also indicates a shell which is slightly more slender with somewhat wider sutures than that figured by Sars, but this variation is certainly no more than would be expected within a single species.

The single empty specimen found during the present study in sample 5 (1,210 fm) is a juvenile but is closer to *acicula* s. str. than to *stimpsoni*. Apparently the two forms are not allopatric, and since no significant differences appear to exist between them they should not be regarded as taxonomically distinct.

T. acicula has been reported from nearly all arctic areas that have been studied in detail. It is distributed all along the perimeter of the Arctic Ocean and as far south as Cape Cod in the Western Atlantic, Finmark in the Eastern Atlantic, and San Diego, California, in the Eastern Pacific. Minimal and maximal bathymetric records (with the omission of the present empty specimen record) are one (Thorson, 1944) and 186 fathoms (Gorbunov, 1946a).

Family NATICIDAE

Natica clausa Broderip and Sowerby

(Plate II, fig. 9)

Natica clausa Broderip and Sowerby, 1829, Zool. J. 4, no. 15, art. 48, p. 372, pl. 9.

Five specimens of this species without the soft parts were taken in three samples ranging from 389 to 1,240 fathoms. *N. clausa* appears to extend around the entire perimeter of the Arctic Ocean and as far south as Japan, British Columbia, Cape Hatteras, and the Mediterranean (Thorson, 1944; Gorbunov, 1946a; LaRocque, 1953; and MacGinitie, 1959). In addition to the records listed by these authors, the National Museum of Canada possesses material from numerous localities in arctic Canada, including the northernmost tip of Ellesmere Island. Minimal and maximal recorded depths for *N. clausa* are 0 and 1,537 fathoms, although the deepest records may be based on dead specimens.

Polinices pallidus (Broderip and Sowerby)

Natica pallida Broderip and Sowerby, 1829, Zool. J. 4, no. 15, art. 48, p. 372, pl. 9.

Two empty shells of *P. pallidus* were found during this survey, one at 1,240 and one at 1,245 fathoms west of the Chukchi Rise. Geographically, the distribution of this species closely parallels that of *Natica clausa*, except that it is known from the Eastern Atlantic only as far south as Belgium and northern England, instead of extending to the Mediterranean as does *N. clausa*. Bathymetrically, *P. pallidus* has been recorded from 0 to 1,330 fathoms.

Family LAMELLARIIDAE

Velutina undata Brown

Velutina undata Brown, in Smith, 1829, Mem. Wernerian Nat. Hist. Soc. Edinburgh, 8, pt. 1, p. 102, pl. 1, fig. 15.

One empty shell of *Velutina undata* occurred in 1,245 fathoms, west of the Chukchi Rise. This is another species which occurs around the entire

rim of the Arctic Ocean. It also extends south in the Eastern Atlantic to Christianssund, Norway, and to Scotland (Thorson, 1944); in the Western Atlantic to Chelsea, Massachusetts (Gould, 1870); and in the Pacific to the Kudobin Islands, Alaska Peninsula (MacGinitie, 1959). Its maximal and minimal bathymetric records are 0 (low tide at Eastport, Maine, personal observation) and 616 fathoms (North Atlantic, Thorson, 1944).

Family BUCCINIDAE¹

Colus hunkinsi Clarke

Colus hunkinsi Clarke, 1962, Breviora, no. 119, p. 3, pl. 1, fig. 9.

Six empty shells of this species, all more or less fragmentary, occurred in four samples from the western edge of the Chukchi Rise in depths of 290 to 1,085 fathoms. Dead specimens of *C. hunkinsi* are also known from three other dredge hauls taken from Station Alpha in a region approximately 800 miles north of Point Barrow, Alaska, in depths of 924 to 1,208 fathoms. No living specimens of the species have yet been found.

Family TURRIDAE

"*Oenopota*" *inequita* (Dall)² (?)

Lora inequita Dall, 1919, Proc. U.S. Nat. Mus. 56 (2288): 44, pl. 16, fig. 9.

Three dead and broken specimens were found (296–320 fm) which agree better with Dall's figure and specimens of *Lora inequita* than with any other species. The specimens here reported lack the longitudinal folds of *inequita*, but their condition is so poor that additional characters are not visible to confirm or deny the present identification. The geographic range of *O. inequita* was given by Dall as Plover Bay, Bering Sea, south to Boca de Quadra, Alaska. No bathymetric range was included, and no additional information has ever been published.

"*Oenopota*" *pyramidalis* (Strøm)

Buccinum pyramidale Strøm, 1788, pt. 5, new series, Kongl. Danske Vidensk. Skrift., 3: 297, pl. 1, fig. 22.

One empty shell of this species was taken in 389 fathoms on the western side of the Chukchi Rise. It is distributed around the whole Arctic Ocean and extends to Lofoten and north of the Hebrides in the Eastern Atlantic, to Martha's Vineyard in the Western Atlantic, and to Friday Harbour, Washington, in the Eastern Pacific. Maximal and minimal bathymetric records are 0 and 1,100 fathoms. This is *Lora pleurotomaria* (Couthouy) 1838.

¹ *Colus*, *Neptunca*, and related genera are sometimes placed in the separate family Neptunidae, as in LaRocque, 1953, and Clarke, 1960. It is perhaps better to consider this group as a subfamily within the Buccinidae, however.

² The genus *Oenopota* is used tentatively for this and the next species following the provisional procedure of MacGinitie (1959). A revision of the family Turridae is now under way by A. W. B. Powell.

Family SCAPHANDRIDAE

Cylichna alba (Brown)

(Plate II, fig. 2)

Volvaria alba Brown, 1827, Illus. Conchol. of Great Britain, p. 3, pl. 19, fig. 43, 44.

Three empty shells of this species were found, two at 1,210 and one at 1,245 fathoms, west of the Chukchi Rise. This is another circumarctic species, occurring as far south as Lofoten in Norway; North Carolina; San Diego, California; and Japan. Minimal and maximal bathymetric records are one and 1,366 fathoms (Clarke, 1962).

Family SIPHONODONTALIIDAE

Siphonodentalium lobatum (Sowerby)

(Plate II, fig. 1, 4, and 5)

Dentalium lobatum Sowerby, 1860, Thes. Conchyl. 3: 100. Figured by Henderson, 1920, U.S. Nat. Mus., Bull. 111, pl. 16, fig. 1, 9.

Of the 144 specimens of *S. lobatum* found during this survey (290–1,245 fm), two in sample 4 (1,245 fm) were alive. This is a panarctic species with boreal outposts, having been recorded as far south as Cape Hatteras, Southern Ireland, and Western Portugal (as *S. vitreum* Sars) in 15 to 1,813 fathoms (Clarke, 1962).

Family NUCULIDAE

Nucula zophos Clarke*Nucula zophos* Clarke, 1960, Breviora, no. 119, p. 5, pl. 1, fig. 15–18.

In addition to 90 single valves of this species found in seven samples (290–1,210 fm), eight living specimens were found in five samples. Since all the original specimens of *N. zophos* were single valves, an approximate bathymetric range for the species can now be given for the first time, viz. 290 to 1,245 fathoms. It is known only from the central part of the North Canadian Basin, Arctic Ocean.

Family MALLETIIDAE

Malletia abyssopolaris Clarke*Malletia abyssopolaris* Clarke, 1960, Breviora, no. 119, p. 7, pl. 1, fig. 19–22.

Three single valves of this species were found in sample 15 (1,085 fm). The original material consisted of 88 single valves from six samples varying in depth from 924 to 1,370 fathoms collected about 800 miles north of Point Barrow, Alaska. Since no living specimens have yet been found, one cannot define its geographic or bathymetric range with any certainty, but *M. abyssopolaris* is probably a deep-archibenthal and abyssal species of the North Canadian Basin.

Family NUCULANIDAE

Ledella tamara Gorbunov

(Plate II, fig. 10 and 11)

Ledella tamara Gorbunov, 1946, Dreifuiushchaia ekspeditsiia Glavseomorputi na ledokol'nom parokhodi "G. Sedov" 1937-1940 gg. Trudy 3: 314, 320, pl. 3, fig. 4a, b. Type figures reproduced below, Plate I, fig. 2 and 6.

Single valves (243) of *L. tamara* occurred in every sample (290-1,245 fm) and a total of four living specimens were dredged in samples 5 and 10B. Gorbunov described this species from a single dead specimen taken in 3,700 to 3,800 m (=2,023-2,078 fm) near the New Siberian Islands. In addition, Wagner (1962, p. 4) tentatively identified this species from material dredged in 258 fathoms near Borden Island, Queen Elizabeth Islands. The writer has examined these specimens, and they are definitely *L. tamara*, but since preservative was unavailable when the material was collected, it is now impossible to determine whether they were taken alive or dead.

L. tamara appears to have a wide distribution in the North Canadian Basin, even extending slightly beyond the western edge of that area. Present studies indicate a minimum bathymetric distribution of 389 to 1,210 fathoms, and it probably extends well beyond this.

Portlandia (Yoldiella) frigida (Torell)¹

(Plate II, fig. 6, 7, and 8)

Yoldia frigida Torell, 1859, Bidrag till Spitzbergens Molluskfauna, Stockholm, p. 148, pl. 1, fig. 3.

Eight living specimens and 120 single valves of *P. frigida* were found during the present survey, with both living and dead specimens spanning the whole depth range sampled, i.e., 290 to 1,245 fathoms. This species occurs throughout the whole Arctic Ocean. Ockelmann (1958) has found that many, and perhaps all, of the numerous more southerly records are based on misidentifications, chiefly of *P. fraterna* (V. & B.). Maximal and minimal depths are 3 (Ockelmann) and 1,245 fathoms (this survey).

Portlandia (Yoldiella) intermedia (M. Sars)

(Figured in Clarke, 1960, fig. 6-8)

Yoldia intermedia M. Sars, 1865, Om de i Norge Forekommende fossile dyrelevninger fra quartaerperioden, Kristinia, p. 38, fig. 92-96.

Two living specimens, one at 1,132 and one at 1,240 fathoms, were taken during this survey in addition to 1,010 single valves (1,132-1,245 fm). This is another panarctic species which extends southward into bor-

¹If the Rules of Zoological Nomenclature are interpreted liberally, the type species of *Yoldia* Müller 1842 by subsequent designation of Verrill and Bush (1898) is *Y. arctica* Müller (not *Nucula arctica* Gray). *Y. arctica* Müller is a synonym of *Y. hyperborea* Torell. Thus *Yoldia* is not synonymous with *Portlandia* whose type by subsequent designation of Dall (1898) is *Yoldia glacialis* Wood (= *N. arctica* Gray). A petition to formalize this conclusion and to preserve the name *Portlandia* for its customary usage will be submitted to the International Commission on Zoological Nomenclature.

dering oceans. Its southern limits are recorded as Norton Sound, Alaska; the Shetlands; and Bohuslan, southern Sweden. Minimal and maximal bathymetric records are 4 to 5 and 2,023 to 2,078 fathoms (Clarke, 1962).

Family ARCIDAE

Bathyarca frielei (Friele)

(Figured in Clarke, 1960, fig. 10-13; also this paper, Plate II, fig. 12 and 14)

Arca frielei (Jeffreys MS.) Friele 1877, *Nyt Magazin for Naturvidenskaberne* 23: 2.

Ten living specimens (296-1,245 fm) and 169 single valves (290-1,245 fm) were dredged from Station Charlie. In addition to the remarkable variation in shape mentioned previously (Clarke, 1960: 9), there are striking differences in shell size between the various stations, those from station 15 (1,085 fm) being unusually large. Great variability in the shape and relative positioning of hinge teeth also occurs, some specimens having short teeth (especially anteriorly) which are nearly perpendicular to the hinge line; many others possess only elongate teeth anteriorly and posteriorly which are parallel to the hinge line. All intergrades exist between these extremes. Two common variations are shown on Plate II, fig. 12 and 14.

A. frielei apparently occurs throughout the whole Arctic Ocean and in the Norwegian Basin of the North Atlantic. Its bathymetric limits, as far as presently known, are 10-12 to 1,540 fathoms. Ockelmann (1958) considers more southerly records and North American records to be incorrect. A monographic revision of *Bathyarca* is badly needed.

Family MYTILIDAE

Dacrydium vitreum (Möller)

Modiola ? vitrea Möller, 1842, *Index Molluscorum Groenlandiae*, C. A. Reitzelii, p. 19.

One living specimen and a single valve of *D. vitreum* were dredged from Station Charlie in 389 fathoms, and an additional single valve was dredged in 1,132 fathoms. The only specimen complete enough for measurements, the single valve from 1,132 fathoms, is 3.0 mm long and 2.1 mm high. It is therefore close to the measurements for *D. pacificum* given by Dall (1916), i.e., length, 3.6; height, 2.5; diameter 1.5 mm, and may belong to that species. Ockelmann (1958: 50) has shown that *D. vitreum*, although often 5.4 to 6.2 mm in length, is variable in shape and is sometimes proportionately quite similar to the measurements quoted for *D. pacificum*. Ockelmann has also indicated that several distinct species have been confused under *D. vitreum* however, and until the genus has been studied in detail it would be premature to synonymize *vitreum* and *pacificum*.

Dacrydium vitreum has been recorded from several localities in the Arctic Ocean and probably occurs throughout that region. It is also recorded from the Atlantic as far south as Nova Scotia, Iceland, and Norway. Presently known bathymetric limits (excluding questionable records) are 3 to 1,235 fathoms (Ockelmann, l.c.).

Family PECTINIDAE

Cyclopecten (Delectopecten) greenlandicus (Sowerby)

Pecten Greenlandicus Sowerby, 1842, Thesaurus Conchyliorum, pt. 2. London, p. 57, pl. 13, fig. 40.

Two single valves of this species were dredged, one from 1,210 and one from 1,245 fathoms. It occurs throughout the Arctic Ocean (including the Chukchi Sea) and in the Atlantic as far south as the Newfoundland and Canaries basins. Bathymetric limits are recorded as 2 to 2,080 fathoms (Clarke, 1962), but abyssal records probably represent empty shells. It is often impossible to determine from the literature whether records represent living or dead specimens.

Hyalopecten frigidus (Jensen)

(Figured in Clarke, 1960, pl. I, fig. 1-3)

Pecten frigidus Jensen, 1912, The Danish Ingolf Expedition 2 (5), Lamellibranchiata, pt. 1, p. 33, pl. 1, fig. 7a-f.

One broken valve of this species was found in 1,085 fathoms. It is known from several scattered localities in the Arctic Ocean (Gorbunov, 1946a; Ockelmann, 1958; Clarke, 1960) and probably occurs throughout the whole area at suitable depths. *H. frigidus* is also recorded from the Norway Basin. Minimal and maximal bathymetric records are 656 and 2,080 fathoms.

Family LIMIDAE

Limatula hyperborea Jensen

(Plate II, fig. 13)

Limatula hyperborea Jensen, 1909, Medd. om Grønland 29: 329, fig. 1a-d.

One living specimen (389 fm) and eleven single valves (320-1,240 fm) of what appears to be *L. hyperborea* were dredged during this study. The largest complete valve measures 8 mm by 5 mm, but several fragments are apparently from much larger specimens.

L. hyperborea has been recorded from several localities in the Norwegian Sea and in the Arctic Ocean from northwest Greenland east to the East Siberian Sea. The occurrences in the Chukchi Sea here reported represent an extension of its previously known range. Probably the lack of collecting is the reason for no existing records from arctic North America. Minimal and maximal bathymetric records for living specimens are 40 fathoms (east of the New Siberian Islands; Gorbunov, 1946a) and 716 fathoms (north of the Faroes, Ockelmann, 1958).

The most complete discussion of this difficult genus is by Jensen (1912).

Family SAXICAVIDAE

Cyrtodaria kurriana Dunker

Cyrtodaria kurriana Dunker, 1862, Malakozool. Blaetter, p. 38.

A single valve of this species occurred in sample 10B (389 fm). Published records of *C. kurriana* indicate that it is probably distributed around the entire perimeter of the Arctic Ocean (Ockelmann, 1958; Wagner, 1962) and south to Norton Sound, Alaska; Ungava Bay, Labrador; and Novaya Zemlya, USSR, in depths of one-half to 31 fathoms. Single valves have been recorded from 1,292 fathoms north of Siberia, but these were probably transported by ice (Clarke, 1962).

Hiatella arctica Linnaeus

Mya arctica Linnaeus, 1767, Systema naturae, Ed. 12, p. 1113.

A single valve, undoubtedly transported from shallow water, was found in sample 10B (389 fm). *H. arctica* occurs around the entire rim of the Arctic Ocean and south into the boreal Atlantic and Pacific in shallow water. Because of probable confusion with other species, the limits of its distribution cannot be defined with certainty. For discussions of this problem see Thorson, 1928; Ockelmann, 1958; MacGinitie, 1959; and Clarke, 1960.

Family VERTICORDIIDAE

Lyonsiella uschakovi Gorbunov

(Plate II, fig. 3)

Lyonsiella uschakovi Gorbunov, 1946, Dreifuishchaia ekspeditsiia Glavseomorputi na ledokol' nom parokhodi "G. Sedov" 1937-1940 g.g. Trudy 3: 316, pl. 1, fig. 4a-c. Two of these figures are reproduced below on Plate I, fig. 1 and 5.

A single, partly broken valve of what appears to be this species was taken in sample 10B (389 fm). The valve reported by Clarke, 1960, as *L. alaskana* Dall is probably *L. uschakovi* also. So far, *L. uschakovi* is known only from dead specimens collected at two stations by the Sedov north of the New Siberian Islands (80° 58' N., 142° 50' E., 807-825 fm; 81° 13' N., 140° 03' E., 891-1,039 fm); by Station Alpha north of Point Barrow (84° 34' N., 146° 24' W., 1,208 fm); and during the present survey.

A monographic treatment of *Lyonsiella* is needed to clarify the relationship between *L. uschakovi*, *L. alaskana* Dall, *L. jeffreysi* Friele, and other similar species.

RÉSUMÉ

Des dragages archibenthiques et abyssaux ont été exécutés en 1959 et en 1960 de la station Charlie établie sur une banquise arctique à la dérive, en vertu d'un vaste programme de recherches océanographiques entreprises par le Lamont Geological Observatory, de l'Université Colum-

bia. Neuf dragages réussis ont été effectués sur le flanc ouest du haut-fond de Chukchi, à 800 milles environ au nord du détroit de Béring. L'une des vingt-quatre espèces de mollusques récoltées est nouvelle (*Alvania karlini*); l'auteur traite de la taxonomie et de la répartition des autres espèces puis il passe en revue la documentation pertinente d'origine russe. Des vignettes illustrent huit espèces arctiques peu connues qu'a décrites Gorbunov et huit des espèces récoltées au cours de la présente étude.

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PLATE I

Arctic molluses described by Gorbunov (1946a). Photographic copies of his type figures.

- Fig. 1, 5. *Lyonsiella uschakovi*, length 5.7, height 5.8, diameter 44 mm; type locality 80° 58'N., 142° 50'E., 1,475-1,510 m depth.
- Fig. 2, 6. *Ledella tamara*, length 3.3, height 2.4, diameter $0.8 \times 2 = 1.6$ mm; type locality 82° 51'N., 137° 23'E., 3,700-3,800 m.
- Fig. 3, 7, 11. *Thyasira ottoschmidtii*, length 3.1, height 2.8, diameter 1.9 mm; type locality 82° 51'N., 137° 23'E., 3,700-3,800 m.
- Fig. 4, 8, 12. *Portlandia annenkovae*, length 2.1, height 1.3, diameter 1.0 mm; type locality 82° 09'N., 83° 08'E., 698 m.
- Fig. 9, 10. *Admete sadko*, height 9.1, diameter 7.2 mm; type locality 75° 22'N., 135° 00'E., 40 m.
- Fig. 13, 17, 18. *Diaphana makarovi*, height 2.7, diameter 1.7 mm; type locality 78° 13'N., 142° 13'E., 57m.
- Fig. 14, 15, 19. *Tindaria derjugini*, length 12.0, height 8.4, diameter 5.6 mm; type locality 81° 10'N., 137° 17'E., 2,500 m.
- Fig. 16, 20. *Ganesa bujnitzkii*, height 2.0, diameter 2.8 mm; type locality 82° 51'N., 137° 23'E., 3,700-3,800 m.

PLATE I

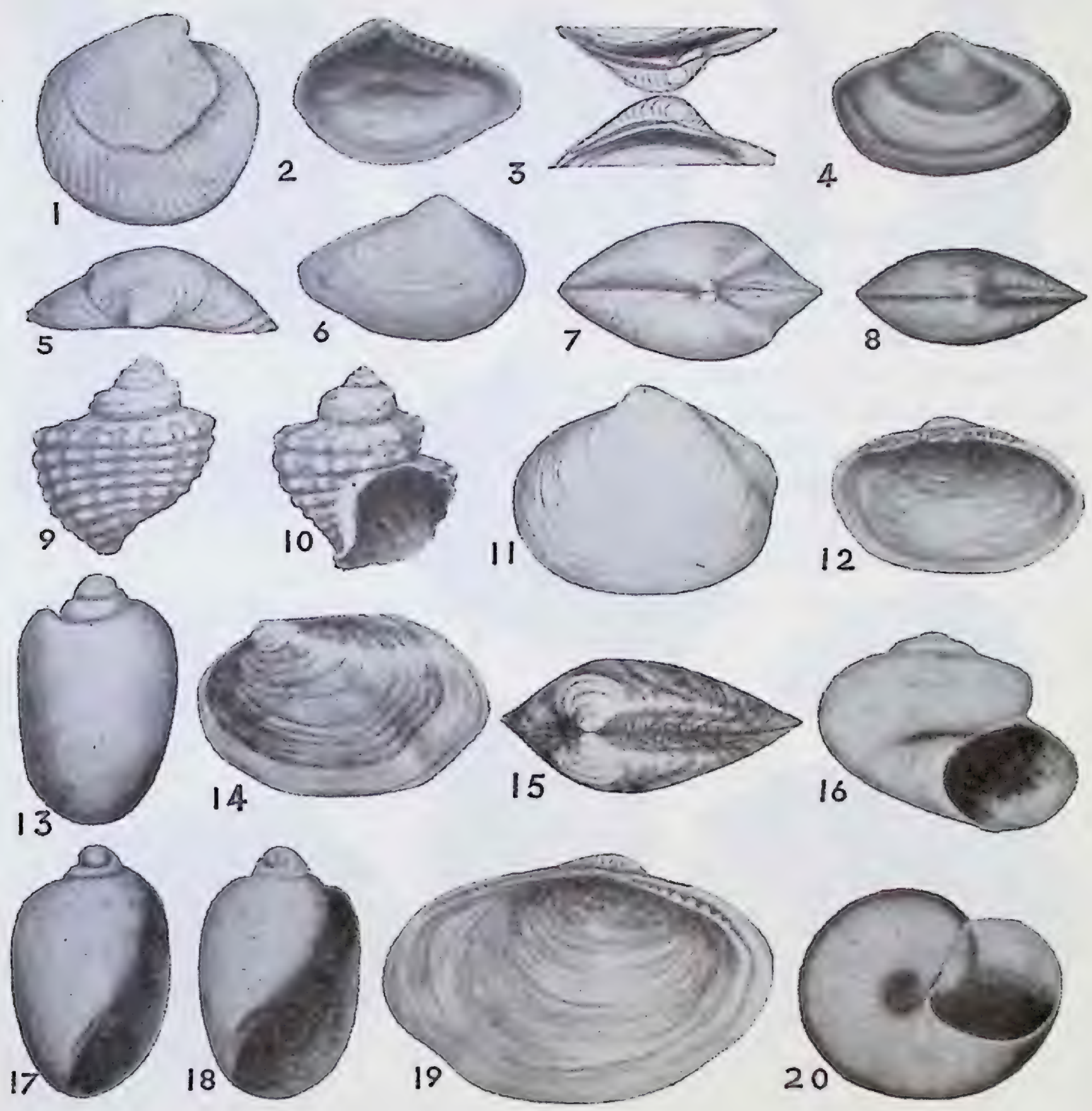


PLATE II

Arctic archibenthal and abyssal molluscs from Station Charlie and Station Alpha

Fig. 1, 4, 5. *Siphonodentalium lobatum*, Charlie sample 5 (fig. 5 shows the apex of the specimen in fig. 4, highly magnified).

Fig. 2. *Cylichna alba*, Charlie sample 4.

Fig. 3. *Lyonsiella uschakovi*, Alpha sample 7.

Fig. 6-8. *Portlandia* (*Yoldiella*) *frigida*, Charlie sample 5.

Fig. 9. *Natica clausa*, Charlie sample 10B.

Fig. 10, 11. *Ledella tamara*, Charlie sample 2.

Fig. 12, 14. *Bathyarca frielei*, Charlie sample 15.

Fig. 13. *Limatula hyperborea*, Charlie sample 10B.

Fig. 1, 2, 3, 4, 9, 12, 13, and 14 are 5X; fig. 6, 7, 8, 10, and 11 are 10X, and fig. 5 is 20X.



